

MARCH 1967 35 CENTS

# Popular Science

MONTHLY

**Special Save-It Section:  
High-Speed  
Math Short Cuts**

**UFOs—The Sense  
and the Nonsense**  
By PHILIP WYLIE

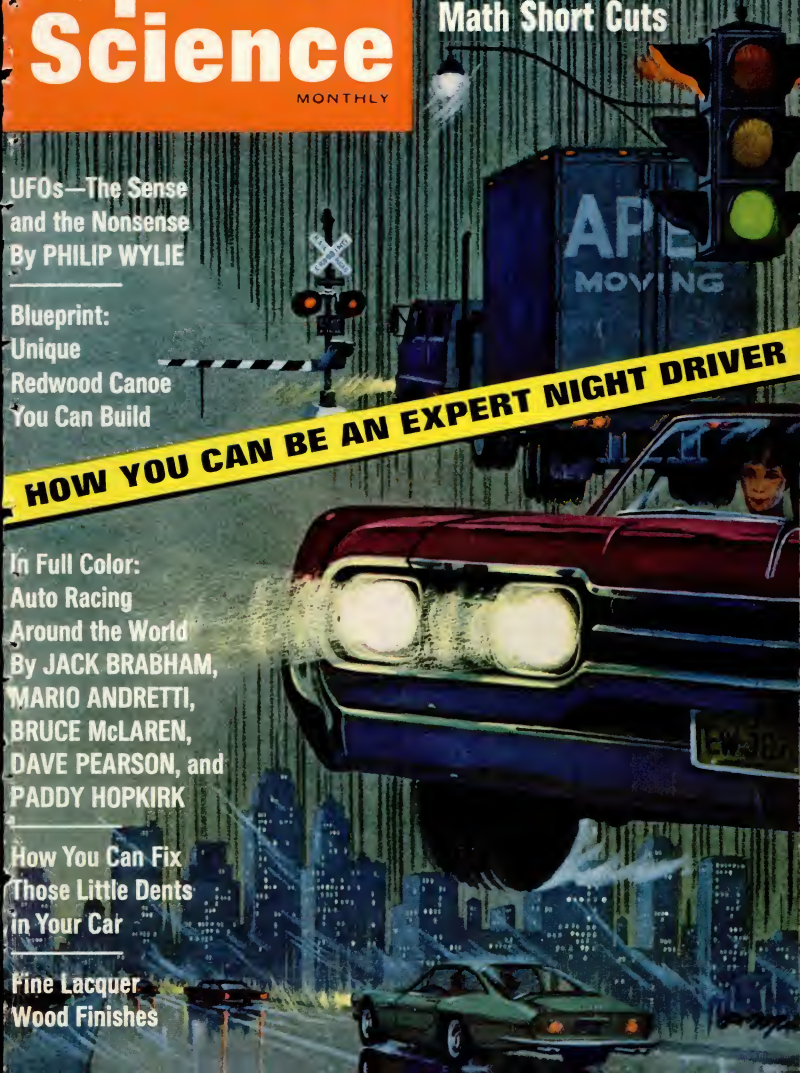
**Blueprint:  
Unique  
Redwood Canoe  
You Can Build**

**HOW YOU CAN BE AN EXPERT NIGHT DRIVER**

**In Full Color:  
Auto Racing  
Around the World**  
By JACK BRABHAM,  
MARIO ANDRETTI,  
BRUCE McLAREN,  
DAVE PEARSON, and  
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# Popular Science

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March, 1967

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SP-2

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## HIGHLIGHTS OF THIS ISSUE:

### Auto Racing Around the World PAGE 69

Five top drivers in five kinds of racing tell you why a particular type of racing is for them.

### UFOs: The Sense and the Nonsense BY PHILIP WYLIE PAGE 76

Beings from outer space? There's no scientific evidence, but this famous author forecasts what the newest group of investigators will find.

### How You Can Be an Expert Night Driver PAGE 82

Learn the rules and you'll tick off more miles, relaxed and in safety, after dark.

### High-Speed Math Short Cuts PAGE 119

Handy Save-It Section: Quick and easy ways to do practical everyday figuring.

### Redwood Canoe . . . a Beauty You Can Build PAGE 171

Own a new 74-pound, 16-foot canoe for \$84. The lie-flat PS blueprint makes it a cinch.

COVER PAINTING BY PIERRE MION

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## COMING NEXT MONTH

Home dwellers won't be interested, but everybody else should have our 40-page April Save-It Section on Home Improvement. It's packed to the rafters with new ideas and solid information to help you make your home more attractive, more spacious, and more fun to live in—with less care and less cash. Here's a quick rundown:

Two basic rooms you can add to any home (blueprint included)

News on floor coverings and wall paneling

Windows and doors that slide on air

How to cut your plumbing bills

New products to improve your home

Concrete can be colorful

A good workbench: your own home-improvement center (another blueprint)

and in the same issue:

Norbye/Dunne report on the compact cars

A whirlwind solution to traffic jams

How good are those hi-fi gadgets?

Are you wasting money on health aids?

How the '67 cars ran in the Pure Oil Trials

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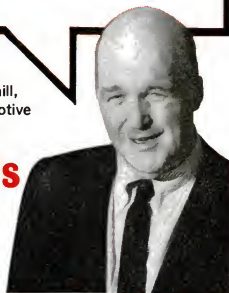
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authority

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MARCH 1967 | 3

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- ☐ Accounting
- ☐ Bookkeeping
- ☐ Real Estate

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Address.....County.....

City & State.....Zip No.....

Occupation.....Working Hours.....A.M.....P.M.

842

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# PS Readers Talk Back

Want to get something off your chest?

Write "Readers Talk Back," POPULAR SCIENCE, 355 Lexington Ave., New York, N.Y. 10017.

## Rotary-engine fumes

Your comparison of various rotary engines in "Rivals to the Wankel: A Roundup of Rotary Engines" [Jan.] was excellent and I enjoyed reading it. But unfortunately you failed to mention the one big drawback each of them has in-



herited from the piston engine—smog. But I wish that these engines had made their appearance 10 years ago.

PAUL DI BIASE, Woodland Hills, Calif.

## Hooray for January

Your January issue was one of the best that you have published. I thought of one thing, though, that would be a welcome addition to your succeeding issues. Why not compare other things in your magazine—not just very large and expensive items, but smaller things such as portable power tools and smaller portable radios?

JOHN H. JERMAN, Doylestown, Pa.

## Secrets of Japanese carpentry

In "The Strange Tools and Exotic Secrets of Japanese Carpentry" [Jan.], you say the joint-work used is tongue and groove. I disagree. They are mortise-and-tenon joints. Tongue-and-groove joints usually run the perimeter edge of a board and are used in covering up large areas such as flooring and siding. Mortise-and-tenon joints are a form of joinery used to connect structural members.

THADDEUS J. PROROK, Ludlow, Mass.

## Downshifts on Smokey

I am going to take issue with our "Smokey" [Nov.] where he urges against downshifting when approaching corners. It has been my standard practice for nearly 40 years to downshift when approaching any obstacle like a sharp corner or mudhole. My primary reason is not to save brakes, but for efficiency and safety. I do

not lug the motor, stall, or lose traction. If it should become necessary to accelerate rapidly, I am ready for it, without having to make a sudden shift when both my hands are busy steering. In all this time there has been no damage to drive lines that I could ever detect. My secret—double-clutching—eliminates the worst of the shock and the drive line can stand it. All auto makers urge downshifting, even to low gear, when driving in mountains where there are sharp grades that sometimes continue for miles.

JOHN F. DAPRA, Sunrise, Wyo.

## Likes to Spot-the-Cars

Thanks for sponsoring your "Spot-the-Cars Game." I'd like to see more of them in the magazine in the future.

STEVE SALAETS, Las Vegas, Nev.

## Little late on ILTS idea

John B. Ligon is a little late with his suggestion for a view alarm in "I'd Like to See Them Make" [Jan.]. General Electric already makes such a device. When the alarm lever is in the "on" position, a small dot of light glows in the corner of the dial.

C. RAINFORTH, Richmond, Mass.

... Sunbeam makes a clock with a light that indicates when the alarm is set.

CHRIS TIFFANY, Walled Lake, Mich.

## Objects to TV in the wilderness

I consider your December issue one of your best, but I object to E. F. Lindsley's "Emergency Generators for Everyday Use" in which he says they are useful to power TVs on camping trips. I agree this is feasible, but I object to it because it detracts from the spirit of camping. I consider



it immoral to watch TV on a camping trip and I hope there are others who agree.

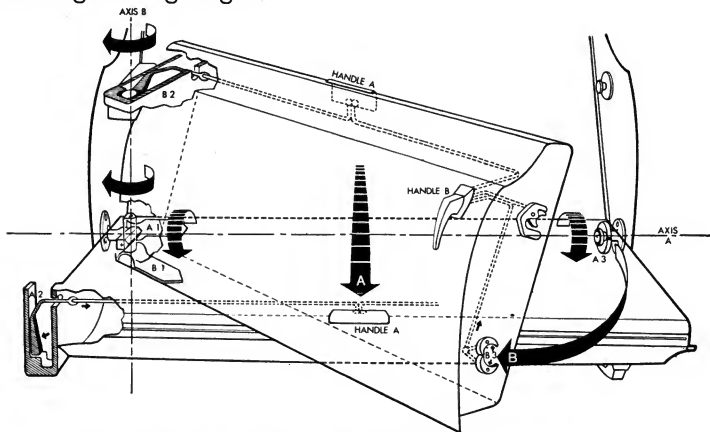
DICK BENSEN, New Canaan, Conn.

## Anchors aweigh

I thoroughly enjoyed "I Crossed the Atlantic in a 12-Foot Boat, Part I" [Jan.] by William E. Verity and will try out his fish trap to see how it works. It looks like the Navy could add this item in life-raft and personnel survival kits, if it works. Your illustrator for "Sea-and-Air Armada to Aid Flight to Moon" [Jan.] must be a landlubber because he has two communications

*Continued*

## New Engineering Magic:



## Ford's better ideas bring out the best in wagons

It took Ford engineers to devise the Magic Doorgate which lets you swing it out like a door, or down like a tailgate—whichever way you want, whenever you like.

**Secret of the Magic Doorgate,** which is available on all Ford station wagons, rests in its three ingenious hinges that work two ways.

At the lower left of the Doorgate (faced from the rear) is a double hinge with pins on both horizontal "A" and vertical "B" axes.

At the upper left of the Doorgate, a second hinge permits the gate to swing like a door on the vertical axis "B," while at lower right a "bear hug" latch (similar to that used on Ford car doors) forms the other end of the horizontal axis "A."



**To use it as a tailgate** the center release handle is pulled and the hinge at the upper left corner of the Doorgate releases from its pin, the upper right latch releases and the Doorgate swings down hinged on axis "A."



**To use it as a door,** you turn the handle at upper right corner. This releases both upper and lower latches (on the right hand side of the Doorgate) from their pins.

This permits the Doorgate to swing out like a door on vertical axis "B." An interlock between handles "A" and "B" permits gate to work on only one axis at a time.

**Other better ideas** that go into Ford wagons are: a push-button actuated latch for folding second seats that eliminates finger-bending struggle; a dual-facing rear seat (on Ford wagons) that seats up to four children, and a roomy under-floor luggage compartment that's lockable (on Ford and Fairlane wagons) to keep your valuables safely out of sight.

You're ahead in a Ford

# FORD

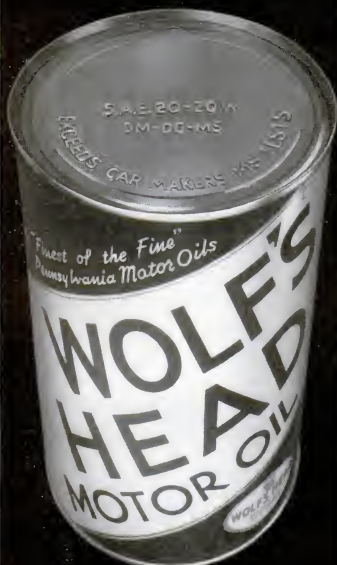
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MARCH 1967 | 7



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## PS Readers Talk Back

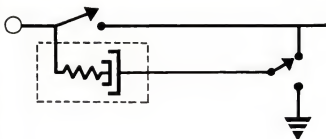
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ships backing down (going backwards) at a goodly rate in his drawing. Tankers are invariably stack/machinery-aft-configured vessels and usually are navigated from a bridge in aft superstructure. Some ships of this type have a navigation bridge in a superstructure mounted amidships, but the Vanguard shown does not.

ANTHONY A. BRADLEY, Lt. USNR,  
Key West, Fla.

### Model Garage hint a hot item

A "Hint from the Model Garage" [Jan.] shows two methods of connecting a cigarette lighter in series with the headlights for a time-delay switch. The first schematic was fine, but the second could prove to heat up more than the cigarette lighter if both switches were turned on. The schematic should look like this:



A3C JOSEPH SZCZECZ JR., Sheppard AFB, Tex.

*Right you are.*

### How not to run out of gas

In "I'd Like to See Them Make" [Oct.], Raymond Himes worries about the problem of propane-gas cylinders running out. A good way to check the contents is to weigh the cylinders. Standard cylinders weigh:

34 ounces.....	full
28 ounces.....	half-full
25 ounces.....	quarter-full
22 ounces.....	empty

FRANK G. BIDANSET, College Point, N. Y.

### Comparing the low-priced three

After reading the Norbye/Dunne report on the '67 Ford, Chevrolet, and Plymouth [Dec.], I feel you did not make a true comparison. The Ford had a two-barrel carb, the others a four. The Chevy had a 327-cu.-in. engine compared to a 390 in the Ford and a 383 in the Plymouth. The Plymouth did not have a standard suspension and the Chevy did not have front disk brakes. You mentioned all these differences, but you failed to do anything about them. I would like to see a true comparison.

JOHN SERLA, Stockton, Calif.

... The Norbye/Dunne report ends up with the difference between an apple, an orange, and a banana—or was it the other way around? Surely the manufacturers could have come up with

*Continued*

# The how-to-glue chart.

## Type of Material

All general gluing of hard and softwoods

Particle and chip boards to wood

Plywood to decorative plastic laminates

Laminating heavy framing members

Veneering, inlays, cabinetwork

Bonding oily woods (teak, pitch pine, osage, yew, etc.)

End-wood joints, mitered joints, scarf joints

Loose-fitting joints, relatively rough surfaces

Doweling

Hardboard to plywood, wood or itself

Gluing porous materials—linoleum, canvas, etc. to wood

Gluing plastics, metal foil, etc. to wood

Gluing non-porous materials—glass, metal, iron, aluminum, bronze, brass, etc.

## Glue For General Usage (In Order of Preference)

Elmer's Plastic Resin Glue  
Elmer's Casein Glue  
Elmer's Glue-All

Elmer's Plastic Resin Glue  
Elmer's Casein Glue  
Elmer's Contact Cement  
Elmer's Glue-All

Elmer's Casein Glue  
Elmer's Contact Cement  
Elmer's Plastic Resin Glue  
Elmer's Casein Glue

Elmer's Plastic Resin Glue (extended)  
Elmer's Glue-All (small jobs)

Elmer's Casein Glue—sponge surface with dilute caustic soda one hour before gluing

Elmer's Glue-All  
Elmer's Plastic Resin Glue (heavy mix)

Elmer's Glue-All  
Elmer's Casein Glue (heavy mix)

Elmer's Plastic Resin Glue  
Elmer's Glue-All

Elmer's Plastic Resin Glue  
Elmer's Casein Glue  
Elmer's Glue-All  
Elmer's Contact Cement

Elmer's Plastic Resin Glue  
Elmer's Casein Glue  
Elmer's Contact Cement

Elmer's Casein Glue (sand both surfaces)

Elmer's Epoxy Glue

## Glue For Maximum Waterproof Durability (Boats, Exterior Construction, etc.)

Elmer's Waterproof Glue

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Elmer's Plastic Resin Glue

Elmer's Waterproof Glue

Elmer's Waterproof Glue

Elmer's Waterproof Glue

Elmer's Waterproof Glue

Elmer's Waterproof Glue

Elmer's Waterproof Glue

Elmer's Contact Cement

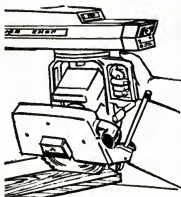
Elmer's Epoxy Glue

**There's an ELMER'S Glue for every job you do.**

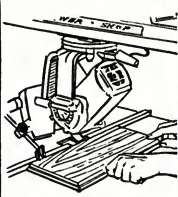
Here's a handy guide for making sure you're using the right glue. Stick-it on your workshop wall. (With Elmer's, of course.) And you'll never have a sticky problem.

**BORDEN  
CHEMICAL**

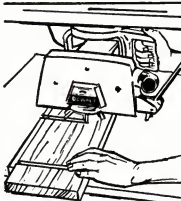




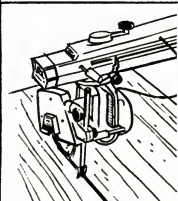
*It's a snap to set your saw for any cut. Bevels, miters, even combination bevel-miters, in one pass.*



*Designs are easy with a shaper. Cut rabbets, molding. DeWalt shapers give 50% more shapes.*



*With new "Quick-Set" Dado, just dial the width you want and dado, rabbet, plough, flute, scallop.*



*Cut wide panels. Big table top gives extra support for accurate ripping beyond center of 4' x 8' panels.*

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It's "operations unlimited" when you own a DeWalt Power Shop by Black & Decker. With accessories, a DeWalt is 14 tools in one! You can saw, size, bore, joint, dado, shape, cut curves, rout, grind, buff, sand, polish...and do it all like an expert, even if you've never worked with wood before. You'll find DeWalts for as little as \$129, along with a full line of accessories, at Black & Decker dealers everywhere. For catalog, write Black & Decker, Dept. C-0377, Towson, Md. 21204.



## **PS Readers Talk Back**

*[Continued]*

more alike equipment than was tested. Your article notes the differences, but I doubt the average driver notices much more than the graphic-chart results.

R. C. CHARLTON, St. Thomas, Ont.

... Your article was very misleading on performance because you tested unlikes. Chevy's braking distance was long because it was equipped with standard brakes and the other cars with front disks. The Plymouth handled better because it had a heavy-duty suspension. I suggest that you be more careful to compare like-equipped cars.

FRED B. FLETCHER Jr., Pueblo, Colo.

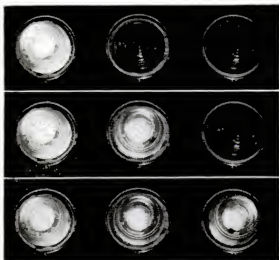
*We make every effort to get cars that are as nearly comparable as possible, but we have to test cars about three months before the magazine reaches you. And the combinations we ask for are sometimes impossible to obtain. We always describe the exact equipment and specifications in detail so that you will know just what is being tested.*

### **1-2-3 turn signals**

Any car owner having the so-called 1-2-3 turn signals described in "Add 1-2-3 Turn Signals to Your Car" [Jan.] is leaving himself open for disastrous results. The system you describe cuts out the turn signal when you need it most—to indicate in which direction you'll go when your slowing or stopping is completed. Haven't you ever followed a driver who bears right while slowing in preparation for a left turn? Unless the following driver were there to see the initial 1-2-3, he'd have no idea what was up.

ROGER L. ALVEY, Monroe, Conn.

*PS's system merely substitutes two sets of three sequential tail-light bulbs for the pair of*



*single lamps in most cars. The car's turn-signal flasher will interrupt and repeatedly sequence the appropriate trio of tail lights even when you're pressing the brake pedal.*



# TOM McCAHILL ADVISES SATURDAY MECHANICS

If you're a Saturday mechanic, my guess is you can fix the screen door, build lawn furniture, overhaul the kid's bike, and rotate your own tires.

It's a different story when that fancy electric coffeemaker stops perking or the push-button automatic washer quits halfway through a cycle. You might spend an afternoon admiring the coffee-maker's innards before giving it a permanent vacation on the top kitchen shelf.

As for the automatic washer, after the Little Lady shouts "Do something!" you'll end up phoning an Appliance Serviceman across town. He shows up in 3 days and has the washer going in one-fourth the time it took you to study the coffee-maker. He also presents you with a ticket for 30 bucks. When you consider he could make twice that selling you a new machine, you got off easy.

Maybe you never realized it, friend, but you have more Appliances around your hacienda today than you did five years ago. If you count power tools, your wife's hair dryer, an air conditioner, plus the standard stuff like vacuum cleaner, toaster, refrigerator, freezer and so forth, you probably have well over a dozen.

These electrical gadgets nowadays represent a pretty good chunk of your hard earned dollars. Did you ever stop to think it could pay you in savings and convenience to know how to fix these things? Also, it could be a great source of extra income if you're inclined to tackle the few thousand broken Appliances right in your own neighborhood.

The Appliance Repair business is easier to learn than you imagine. The National Radio Institute's Appliance Division has a downright interesting, low cost course you can take in your spare time. It covers every type of Appliance you can think of plus air conditioning, refrigeration, house wiring, electric motors — even small gas engines. There's a worthwhile section on farm and commercial appliances too.

NRI starts you with the basic principles of electricity to give you a solid background. Using clear-cut picture diagrams, they show you how various types of Appliances work, separating each into groups. Included with the course is a topnotch, professional Appliance Tester for fast troubleshooting.

Easy to read, bite-size lessons are loaded with photos and cutaway drawings so you see how each Appliance comes apart, and more important — goes back together in working order.

Whether or not you agree that knowing Appliance Repair could help you, I recommend you see for yourself. The coupon below will get you a free book that fully describes this unique home training. No salesman is going to call.

Do yourself a favor and mail the coupon today.

TOM McCAHILL

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☐ Check for facts on new GI Bill.

# "Say, Smokey—"

## A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please print your name and address.



*"I've had a problem with my '65 Dodge since it was new. Flooding occurs when the engine (383-inch, with two-barrel carb) is hot, though occasionally it crops up when the engine is first started. The dealer has adjusted the automatic choke several times and installed a pressure regulator, without success."*

JOHN F. WEILAND, Medicine Lodge, Kans.

Your trouble may be caused by a combination of things: a weak needle and seat and/or a float level too high; high fuel pressure; fuel too hot because parts of the delivery system are located where they overheat. I'd suspect heat. Since gasoline boils at 110 degrees, it doesn't take much heat to expand it, causing excess pressure all along the system, and flooding.

*"Recently you gave advice to a reader seeking parts for a '47 Cadillac. Any idea where I can get parts for my '49 Cadillac?"*

LESTER HEMLINGER, Wapakoneta, Ohio.

Few companies specialize in older parts now, but I understand Warshasky in Chicago stocks them. Sears, Roebuck also is noted for carrying out-of-date parts, many listed in their catalogue. A good tune-up shop or a sharp dealer can get parts—if they really try. Keep looking.

*"I purchased a '61 Mercury Commuter wagon in 1963. Shortly after, the brakes began to give out. They were relined, and the automatic adjusters removed. I've had the linings changed three times and new drums installed. Now, at only 18,000 miles, the brakes are worn out again. What can I do?"*

W. H. JOHNSON, San Francisco

I suspect your real trouble is that you just don't have enough brakes for that heavy wagon in hilly country and for fast city driving. Go to

a good brake shop and get premium lining—like Grey Rock—installed. Have the wheel cylinders checked and repaired as necessary, and the drums finished smooth and true. Be sure to ask the brake man for the correct break-in procedure.

*"Will a Corvair engine fit into a Volkswagen easily? Will the transaxle, differential, transmission, clutch, etc., take the extra power? What are the complications? Is there any other way to get more power out of the VW?"*

DWIGHT W. BEGLEY, Wooster, Ohio.

You can install a Corvair engine, but not easily. You'll find kits for that purpose advertised in the specialty auto magazines. The VW drive train would be weak for a healthy Corvair engine. You can't increase power much in the VW engine unless you turbocharge it.

*"I am considering buying a new Porsche 911, but live 300 miles from specialized servicing for it. I've heard that some of these high-performance foreign jobs need adjustment often. So a Porsche might not do here. What's your opinion?"*

JAMES O. BISHOP, Gillette, Wyo.

As a mechanic—admittedly prejudiced—I say cars are only as good as the service they get. From 300 miles away, it's going to take mighty long wrenches if you intend to maintain that Porsche.

*"My '64 Ford Galaxie with 195 horses, two-barrel carb, and automatic transmission idles rough. I've had the plugs, points, and condenser replaced, and put in a new carburetor and fuel filter. The dwell setting is right. Suggestions?"*

JOHN HAMMOCK, Tampa, Fla.

*Continued*

# There is a difference in spark plugs. That's why AC is Number One\* in America.

AC's balanced design is the big difference in spark plugs. It's the reason why ACs are installed as original equipment on the majority of new cars built in this country.

At Chevrolet, Pontiac, Oldsmobile, Buick and Cadillac Divisions of General Motors, balanced AC Fire-Ring Spark Plugs are specified because ACs meet the rugged demands of all-around driving . . . the kind you do every day.

A competitor of AC would have you believe his booster-gap type spark plugs with extended tips perform better than original-equipment ACs.

What he didn't tell you is this: Not one U.S. car maker installs this type of spark plug—not even the ones who buy from this competitor.

For peak engine power and performance in your own kind of driving, always ask for the best—balanced AC Fire-Ring Spark Plugs. They cost no more.

\*Original Equipment Installation



MARK OF EXCELLENCE



AC SPARK PLUG DIVISION

MARCH 1967 | 13

# PROFESSIONALS USE NICHOLSON FILES.



## DON'T YOU THINK IT'S ABOUT TIME YOU TURNED PRO?

Send for your free copy of the filer's handbook, "File Philosophy." Please include your name, address, zip code.

There's never a dull moment with

# NICHOLSON

Nicholson File Co., Providence, R. I. / Quality cutting tools



### "Say, Smokey—" [Continued]

Get your car to a shop with a "scope" and a mechanic who knows how to use it. Rough idle is usually caused by a too-lean or too-rich fuel mixture in one or more cylinders. It can also be caused by a plug misfiring from low spark or at the wrong time, or because the heat range of the plug is wrong. Tight or sticky valve guides can cause roughness, but the granddaddy of all causes is the carburetor.

*"Before I overhauled the engine in my '55 Ford V-8 pickup at 64,000 miles, it started instantly, ran well, and made no noise, but it had low oil pressure. I had the valves ground, and installed new camshaft bearings, rings, and Ford main and rod bearings. I torqued all bearing caps to specs. Now it still starts and runs perfectly, but has no oil pressure and knocks for about the first four seconds when first started in the morning. A new oil pump failed to help. Should I have had the crankshaft ground? If so, why didn't it knock before the overhaul?"*

MIKE CLICK, Odessa, Tex.

In a nutshell, either you put in the wrong size bearings, or the shaft is so bad that it has already knocked out the new bearings. The shaft has to be round and true to within .0015 inch, and the bearings need from .0015 to .0025 clearance, both rods and main.

*"I travel about 4,000 miles a month in a 1966 GTO with a 389-inch engine, four-barrel carburetor, automatic transmission, and standard 3.23 rear end. On premium fuel, with new plugs and points, and when set at factory specs of six degrees BTC, and 28-30 degrees dwell, I get a tremendous amount of pre-ignition ping when accelerating in high. Even at four degrees BTC it pings slightly. Should I run at three or four degrees? Will the slight pinging at this setting harm the engine?"*

MICHAEL A. MILLISER, Minneapolis.

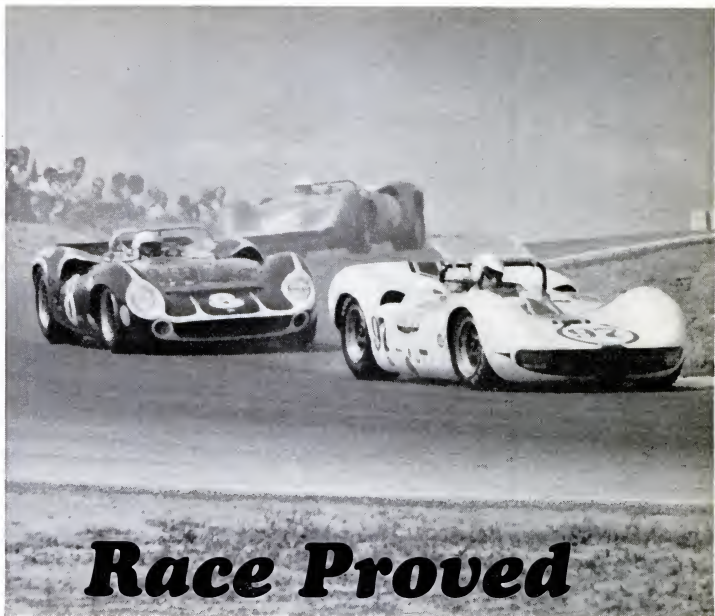
There is something screwy about that ping. It should run fine on factory specs. Have your dealer check for incorrect advance curve in the distributor. There is also the possibility that the premium fuel you use is not all it's supposed to be. Running retarded two or three degrees won't hurt a thing except mileage and performance. But the pinging will wreck the engine.

*"Which gasoline causes the most carbon to form in combustion chambers, high or low test? My car has a 9.6 compression ratio, and I usually drive 70 m.p.h. What should I use?"*

JAMES W. DIXON, Dayton, Ohio

There is no exact answer. Carbon buildup is caused mostly by unburned gas, burned oil, or

*Continued*



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Valvoline is rugged. Dependable. Stands up when the action gets hot. The experience Valvoline has gained in the lubrication of high performance racing engines goes into every grade of Valvoline Motor Oil. ☐ Power! Performance! Protection! With Valvoline you get all three. No matter what kind of car you drive or how you drive it. Only Valvoline contains Chemaloy<sup>®</sup> to make sure your engine stays clean, resists wear, delivers top power. Ask for Valvoline, the race-proved motor oil, where you have your car serviced.

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Division of Ashland Oil & Refining Company

MARCH 1967 | 15



# You'd be proud, too, if you could make 185 horses stampede

Matter of fact, you can—at the reins of the first 185-horsepower stern drive on the market. It's the new 185-hp FASTBACK

OMC Stern Drive, sister of the rampaging FASTBACK 90, 120, 155 and 200. And packing FASTBACK power and performance features to turn a wide gulf or a Great Lake into your personal stomping grounds. Just for example: a steering radius 15° sharper, and electric power tilt 10° higher, than any other stern drive out. Both are standard equipment, too, at no extra cost. What's

more, the whole works is backed by the industry's first full 2-year warranty.\* So, saddle up and

test-drive the new FASTBACK 185—or whichever stampeding FASTBACK you like best. Also, get the 1967 FASTBACK Fact Book by writing:

OMC Stern Drive, Galesburg, Ill.

\*For 24 months after purchase, OMC Stern Drive will replace to the original purchaser of an OMC Stern Drive any part of its manufacture, which upon inspection proves to have failed in normal use due to faulty material or workmanship.

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**FASTBACK**



**OMC STERN DRIVE**

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# Ariens Fairway®

## RIDING MOWERS

Two models — four or five hp engines . . . plenty of power for any mowing job . . . four speeds forward (plus reverse) mean there's a speed to meet the cutting need. Add up all the features of the Ariens Fairways — 26" rotary mower; rear-mounted engine; easy height adjustment; meet all A.S.A. safety standards, and you have plenty of reasons for choosing a Fairway. See your Ariens dealer or write for free details.



## Ariens COMPANY

159 Calumet St., Brillion, Wis. 54110

## "Say, Smokey—"

[Continued]

inefficient exhaust-scavenging design. A diesel engine usually doesn't carbon up any worse, and often far less, than a gasoline engine, yet its fuel is way down on the octane scale. You probably will do better with so-called high-test gas.

*"I'm getting ready to buy an Olds 4-4-2. I'd like to know whether I should break it in hard and fast, since I plan to race it on weekends."*

CHARLES HAMMER, Los Angeles

Most of the high-speed break-in "systems" break 'em in—and ruin 'em. Best way: Break it in at 45 to 55 m.p.h. for approximately 500 miles with minimum start-and-stop driving. In the next 500 miles, it would be safe to run for short bursts up to 70 or 75. Longer trips are best for break-in. Be sure to leave in the break-in oil for the period specified in the owner's manual.

*"I have 48,000 miles on my '64 Falcon with 99-hp. engine and four-speed transmission. I change oil each 2,000 miles and have a tune-up twice a year. I change the filter each 4,000 miles and use detergent oil—10W30 of high quality. For the last three months, smoke has been coming out of the breather. None comes out of the exhaust, and I never burn a drop of oil between changes. How do I stop this smoking?"*

DONALD S. TRASKUS, New Britain, Conn.

The rings are stuck. The smoke you see is from blow-by. Have the compression checked on a Sun compression analyzer. I believe it will show compression-ring leakage. The smoke signal is Step One of burning the side out of a piston.

*"Please settle this argument: A friend says that regardless of the type of manual transmission, the one on the floor will always win out in acceleration over one on the steering column. I say a column-mounted shift is more easily reached, making for faster shifting. Who's right?"*

JON VERNSTROM, Portland, Ore.

I'll put my money on your buddy's side. Floor mounts are usually direct, require less travel, are much more rigid, are better fitted to normal body movements and muscular control. You'd be surprised at the beating the gearshift mechanism takes in competition. It would be very hard to make a column shift strong enough and fast enough for that type of driving.

Got a question on autos? Send it to:

"Say, Smokey—" POPULAR SCIENCE  
355 Lexington Ave., New York, N.Y. 10017.

Not every question may be used. Questions cannot be answered by individual letters.



TURN SIX AT RIVERSIDE

## SHELBY MUSTANG GT 350

American, SCCA Class B production sports car champion in 1965 and 1966. Body style: two-door fastback. Engine: Ford overhead valve V8. Bore and stroke: 4" x 2.87". Displacement: 289 cu. in. Compression ratio: 10.5 to 1. Brake horsepower: 306 @ 6000 rpm. Torque: 329 lbs.-ft. @ 4200 rpm. Induction and exhaust: special free-breathing Shelby design. Transmission: 4-speed synchromesh. Suspension: independent coil spring, front; semielliptic leaf spring, rear. Shelby-modified for 30% less cornering roll. Brakes: disc, front; air-cooled drum, rear. Steering ratio: 16 to 1. Wheelbase: 108". Overall length: 186.6". Weight: 2723 lbs.

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performance  
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its own

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Indy cars. For dragsters. For stockers. For your car, too. Racing is the only road to high-performance know-how. And only Autolite has traveled every inch of it.

## AUTOLITE

...the spark behind the total performance company...



# Science Newsfront

Last-minute news and notes to keep you up-to-date

By W. STEVENSON BACON

## Electric cars called trouble-free

The service station will practically disappear when electric cars take over the streets, says William C. Ryan of Indiana University. The power train on an electric car will need less attention and may well outlast the body and chassis. Instead of offering a completely new car, dealers may simply sell replacement bodies to fit over the old parts. Another change will be coin-operated electricity dispensers for recharging car batteries: They'll be a standard feature along the road and at motels and restaurants.

## Sound creates underwater holograms

Three-dimensional pictures of objects sunk in thousands of feet of water—and perhaps eventually of living, functioning organs within the human body—may be possible with "sound" holography. In conventional holography [see "Amazing 'Frozen Light Waves' Give First True 3D Pictures," July, 1966] light from a laser is split into a beam that illuminates the

object and a reference beam. The interference pattern between the beams is recorded on film and used to create a 3D image. In the new process, being investigated by Bendix, an object under the surface of a liquid is "illuminated" by a sound beam. A reference sound beam interferes, creating an interference pattern on the surface of the liquid. By illuminating this pattern with laser light, an image of the sunken object can be created.

## Rocket runs on garbage

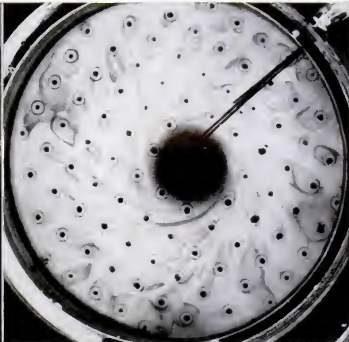
Future astronauts on long missions will be able to put their garbage to good use—as rocket fuel. Paper, water, food and human wastes are simply mixed with a basic fuel, developed by Rocket Research Co. of Seattle for NASA, and used to provide thrust. The system, known as integrated waste-management rocket propulsion, is intended for orbiting laboratories and interplanetary missions where garbage will become a problem. The fuel has been successfully test-fired in a rocket engine.

*Continued*



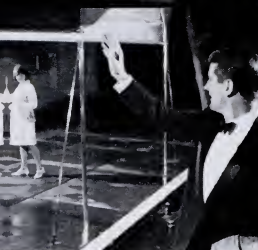
## Hurricanes in the laboratory

A hurricane machine that produces miniature storms that act like the real thing has been constructed by Ronald K. Hadlock of the Florida State University. An acid is poured into a



Plexiglas cylinder that rotates to simulate the earth's rotation. An alkaline solution is fed into the acid through holes in the bottom of the cylinder, producing heat energy like that generated by water condensation in a real storm. Swirling produces a "hurricane" eye (right).

What kind  
of man uses  
Vaseline Hair Tonic?



He's just brought his date home when...



trouble.



Surrounded



Look at pretty boy."



Uh oh! A lead pipe



A crescent foot block. He's got it!



Fair warning.



Some men make their own paths.



The man who knows how to take care of himself  
uses Vaseline Hair Tonic.



CLEAN AND CLEAR





# This is a tubeful of boredom.

(This new kind of tool reduces all  
your challenging, interesting, iffy  
glue jobs to an easy, dull routine.)

No mixing. No fussy application. No clamps to test your skill.

Just *touch*. And *glue*.

One coat of Touch-n-Glue® on one surface sticks it. But you still have plenty of time to straighten things out if you get them crooked.

And you don't even have to decide when to use it. It replaces nails and screws. Bonds metals, ceramics, concrete, wood—practically anything.

In fact, Touch-n-Glue doesn't leave you a thing to do but glue.



**U.S. Plywood Corporation**

777 Third Ave., New York, N.Y. 10017

## Science Newsfront

[Continued]

### "Gatorade" for tired football players

What's the perfect pickup drink? One that has all the chemicals you lose in exerting yourself. So reasoned Dr. Robert Cade of the University of Florida, who has created the most successful lemonade ever for the football team (the Gators). Known as Gatorade, it consists of water, sodium and potassium phosphates (special types of salt), and glucose flavored with lemon extract. While a cup of water doesn't take effect for 30 minutes, research shows athletes absorb Gatorade in two to three minutes because of the salts and sugar. Although some players don't like the taste, all agree that it gives them more stamina.

### An engine powered by sunlight?

A new kind of engine based on the shrinking and expansion of plastic fibers when heated has been built by three Italian scientists. The fibers are tied to a wheel and to weights on the wheel. In one spot they are heated to 170 degrees, causing them to shrink. This moves the weights, changing the center of gravity of the wheel and making it rotate. As it turns, the heated fibers cool and expand, while cool fibers move into the heat and contract, giving continuous power. The inventors believe sunlight could power a similar engine.

### Machine identifies your allergies

Allergies, which may affect one in every 10 persons and make many miserable, can, for the first time, be quickly and precisely identified. A new machine does the job, and also reveals minor allergies that would otherwise go unnoticed. Known as Quicha for Quantitative Inhalation Challenge Apparatus, the device is the invention of allergist Irving H. Itkin. It provides a measured flow of allergen particles of various sizes (pollen or house dust, for example) and air; the patient breathes the mixture through a face mask. Exhaled air is collected and analyzed. By measuring the amount and sizes of the exhaled particles it can be determined how much stayed in the patient's bronchial tree and how deeply it penetrated—a tip-off as to the nature of the allergy.

### Computer analyzes candlelight

One of man's newest tools, the computer, has been put to work analyzing one of his oldest sources of light: a flickering candle flame. The varying chemical reaction and mass and energy flow of the flame proved so complex mathematically that University of Illinois chemical engineer R. A. Schmitz programmed a computer to simulate it. So successful was he that the computer even predicted an oscillating reaction in which the temperature rises and falls: the flickering of a dying candle flame.

Continued

# Join "THE TROUBLESHOOTERS"

who get paid top salaries for keeping today's electronic world running

Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand **THE TROUBLESHOOTERS**—the men urgently needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks—without having to quit your job or go to college to get the necessary training.

**JUST THINK** how much in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter...keep a whole assembly line moving by fixing automated production controls...prevent a bank, an airline, or your government from making serious mistakes by servicing a computer.

Today, whole industries depend on electronics. When breakdowns or emergencies occur, someone has got to move in, take over, keep things

running. That calls for a new breed of technicians—**The Troubleshooters**.

Because they prevent expensive mistakes or delays, they get top pay—and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of **The Troubleshooters**? You might think you need a college degree, but you don't. What you need is know-how—the kind a good TV service technician has—only lots more.

## What You Need to Know

As one of **The Troubleshooters**, you'll have to be ready to tackle a wide variety of electronic problems. You may not be able to dismantle what you're working on—you must be able to take it apart "in your head." You'll have to know enough electronics to understand the engineering specs, read the wiring diagrams, and calculate how the circuits should test at any point.

Learning all this can be much simpler than you think. In fact, you can master it without setting foot in a classroom or giving up your job!

For over 30 years, the Cleveland Institute of Electronics has specialized in teaching electronics at home.

We've developed special techniques that make learning easy, even if you've had trouble studying before. Our **AUTO-PROGRAMMED™** lessons build your knowledge as easily and solidly as you'd build a brick wall—one brick at a time. And our instruction is personal. Your teacher not only grades your work, he analyzes it to make sure you are thinking correctly. And he returns it the same day received.

## Get FCC License or Money Back

Two-way mobile work and many other types of troubleshooting call for a Government FCC License. Even if your work doesn't require a license, it's a good idea to get one. It will be accepted anywhere as proof of good electronics training.

The licensing exam is so tough that two out of three non-CIE men who take it fail. But 9 out of 10 CIE graduates pass. That's why we can offer this warranty. If you complete one of our license preparation courses, you will be able to get your FCC License—or your money back.

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## Science Newsfront

[Continued]

### Pet wasp protects scientist

One of Dr. Norman Lin's best friends is a male cicada killer wasp. So devoted is the insect that it perches on his shoe, flies alongside him when he walks, and defends him from other wasps and flying insects. Describing his research to a recent meeting of the American Association for the Advancement of Science, the Ohio State scientist told how each male cicada stakes out his territory and chases other wasps away. The insect repeatedly returns to his perch—even after a 24-hour delay. The behavior of insects such as Lin's wasps is believed by many scientists to hold clues to understanding human behavior.

### Old antifreeze rusts radiators

You should change the antifreeze in your car radiator at least as often as recommended, according to Dr. B. J. G. Weibull of Moch Domsjo AB, Ornskoldsvik, Sweden. Not only do all mixtures eventually lose their rust-preventing properties, but the coolant suddenly changes from a protective state to a corrosive state. Once the cooling system has corroded, it becomes that much harder to protect. In his tests, Dr. Weibull used ethylene glycol with three different rust-inhibiting compounds: sodium benzoate and sodium nitrite, triethanolamine phosphate and sodium mercapto-benzothiazole and, last, borax. The most dependable rust protection was given by sodium benzoate-sodium nitrite; the least by borax.

### Weather: more probability forecasts

You have to make up your own mind whether to carry an umbrella or wear boots with probability weather forecasts, say weathermen, but they're much more accurate. Percentages—"20 percent chance of rain," and so on—have been used by Weather Bureau forecasters of the Environmental Science Services Administration since last September. Now, probabilities will be applied to the type of precipitation. An example would be: "Probability of precipitation 60 percent. Probability of rain 40 percent, snow 20 percent..."

### It's a bird, it's a plane . . .

The search for a man-powered aircraft that would fly by flapping its wings dates back to Leonardo da Vinci. Now it turns out that such an aircraft may be built and successfully flown. A group of scientists, members of the Royal Aircraft Establishment at Farnborough, England, are planning a "birdcraft" and hope to have it flying within three years. It will look somewhat like a glider with hinged wings, and will be powered by an athletic pilot performing with a rowing motion. Anticipated speed: about 20 m.p.h.

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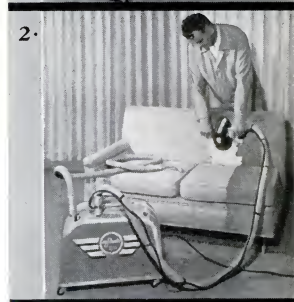
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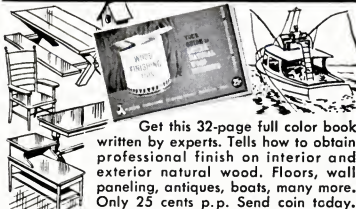
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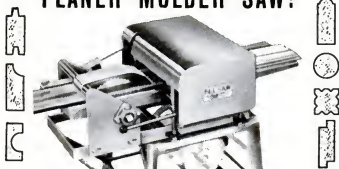
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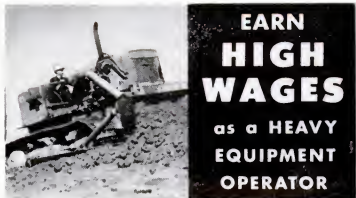
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All over the country it's happening. You may even know some of the men who already have started home operated businesses of their own in their spare hours. They keep their jobs. The "boss" doesn't know they are planning for independence. They do not have any heavy investments in equipment or inventory, because they buy their raw materials as they are needed. They have no overhead expense because they operate their businesses from their homes.

Yet hundreds are quietly developing a second source of income—an extra income right now for their spare hours; and a business that can be quickly expanded if it were ever necessary to look to it for complete support.

Those "little" home businesses are little only in the sense that they require little capital to start and run, and they require little time on the part of the owner. The margins of profit in some of them are so fantastic as to be almost unbelievable—far greater than those usually enjoyed by big investment manufacturing.

And, there are many kinds and types. For the man who is mechanically inclined there are businesses in which he can use his hands as well as his head. For those who have no aptitude with tools there are small manufacturing operations that are almost automatic in their production methods.

One of the features found in many of these businesses is a wide and ready market for the product. Usually it is a product too small in total national market to attract the attention or envy of the big investors. So, the danger of competition from big operators is absent. Usually it is a product that enjoys a neighborhood demand so that good markets are found in any size community from the small town to the neighborhoods of the big city. Usually the cost of the raw materials is only about one tenth the selling price. One such product costs 11c for raw materials, yet sells readily for \$1.00. Another sells for \$18.95, yet the raw materials cost only 55c. Still another returns \$2.75 for each 27c worth of raw materials.

In the same way that history had its "Minute Men," quietly trained and ready at a moment's notice, so today, we have a constantly growing number of "Ready Men." They are working at steady jobs in offices, stores, factories, gas stations. They have a regular income now—an income that only a few months ago was considered both regular and dependable. But when the signs went up, they started quietly to prepare for independence. They are ready. They have mastered the details of their businesses. They have been making twenty, thirty, forty, or more dollars a week as extra money—now—

some times with others in the family helping. They have established the outlets for their products. But, more important than their present extra income, they are ready, overnight, to give their full time and to expand their businesses into full-fledged operations at increased income.

The fear of layoffs is gone from their hearts. The worried look induced by threats of recession has vanished from their faces. They face the future with confidence because they have sown the pennies that will be reaped as dollars when more dollars are needed—they have attained a sense of personal independence that puts them above worry and fear.

What are these businesses? There are a number. One that is especially interesting and that you can own outright for less than \$300.00 is the manufacture of a product used in quantity in every office and factory in the nation—and by millions of individuals.

The product is light in weight and can be delivered to customers by mail for just the cost of a few stamps. And 27c worth of material, to which you add nothing but your own time, brings back \$2.75 in cash at retail. The entire "factory" takes so little space that it can be operated on a table top in any spare room, the basement or garage and it is such a simple process that even the junior members of the family can help. The equipment is supplied by The Warner Electric Company who also give seven different methods of selling the output and give financial help to the men who want to start. The sales methods include a plan by which others sell your product so there is no canvassing needed on your part; another plan by which you sell by mail.

Complete information concerning this and other businesses is free. Information is mailed, postage prepaid, to anyone who is interested. There is no obligation and, since the company has no salesmen, you are not bothered by anyone trying to "sell" the equipment. On the basis of the information mailed, you decide in the quiet of your own home whether you are interested.

It is not necessary to write a letter. Just send your name and address on a postcard and say you want complete free information on various home businesses offered by Warner Electric Company. Address your card to Warner Electric Company, at 1512 Jarvis Ave., Dept. R-3-CT, Chicago, Ill. 60626. You may want to plan a degree of security for the future that is not experienced by men who depend upon the ups and downs of others' businesses for their livelihood.

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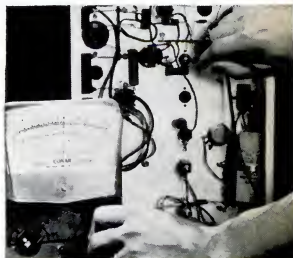
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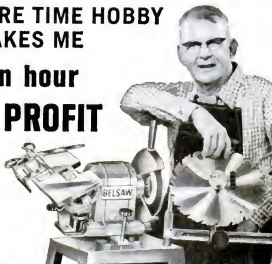


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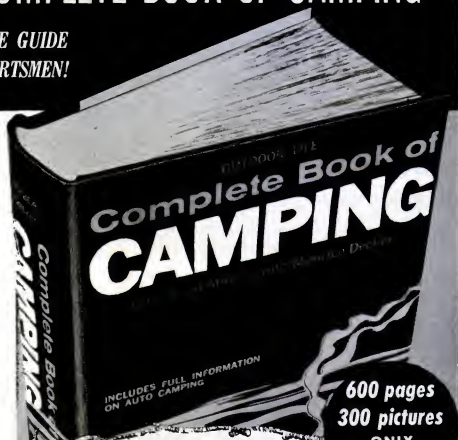
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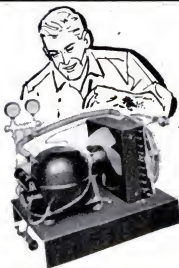
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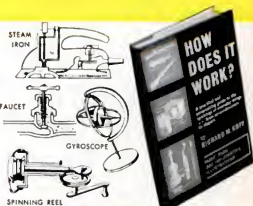
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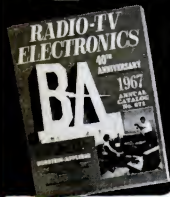
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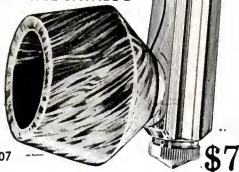
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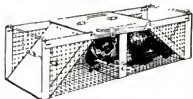
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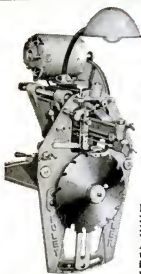
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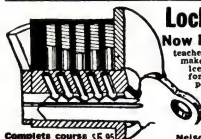
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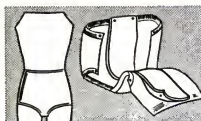
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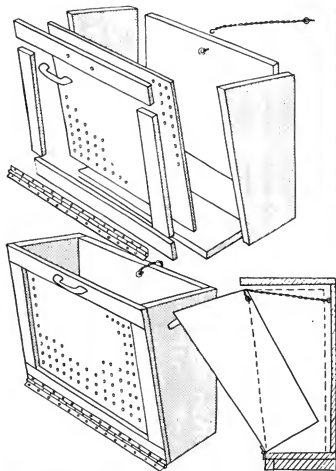
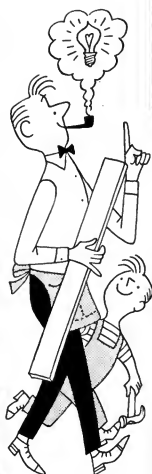
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Mr. Paul Kukonen, member of the "All-American Casting Team", landed a 17-inch bass at Flagg Pond in Shrewsbury, Mass. last October using a Stanley 6' No. X226 folding wood rule.

Stanley designed the first spring joint rule in America in 1899. And we've been improving it ever since.

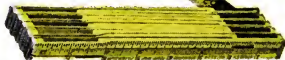
Take the "100 Plus™" joints. They snap tight and stay rigid to eliminate jack-knifing. They won't stretch, and they last over twice as long as other joints.

Those bold, "High Visibility" stud markings aren't

about to wear off because they're protected with StanGuard™.



No. X226  
heavy duty  
folding wood rule



StanGuard resists abrasion, oils, acids, and most alkalies 400% longer than ordinary finishes.

Stanley also uses the finest hardwood sticks to give you a folding wood rule strong enough (yet flexible enough) to land a 17-inch bass.

## Free Sports or Hobby Books

Buy any Stanley folding wood rule and pick any one of these four free pocket-books: "The Compact Book of Hunting", "The Compact Book of Fishing", "Golfers' Gold", and "How To Work With Tools and Wood". Ask the dealer for the free coupon, and mail it to Stanley Tools, Division of The Stanley Works, New Britain, Conn. This offer expires April 30, 1967.

# STANLEY

helps you do things right

# Detroit Report...

**IS FORD WORKING ON A NEW SUB-COMPACT CAR?** Is another Cardinal in the works? Two things are known: Ford will soon bring in the new British-built Cortina in large numbers to compete in the Volkswagen-Opel-Datsun-Renault market. Ford is also studying sub-compact projects in Dearborn and may come up with a small car for manufacture in this country. Apparently, front-wheel drive is not considered (the front-drive Cardinal cost \$50 more to make than the conventional Cardinal). If the button is pushed right now, we could see the car in 1968.

**What's going on with Corvette?** Let's backtrack a little and get the sports-car picture straightened out. I led you astray in January by saying Corvette will have a midship-mounted engine next year. The engine will still be up front even though Corvette will get a complete change in styling. The midship engine mixup came about because Chevy was developing—in parallel programs—both the conventional engine location and midship design for 1968. At the last minute, they decided to delay the midship version for at least another three years—that's when the Corvette is due for its next big body change. Meanwhile, the wild styling of early Corvette prototypes has been toned down somewhat. It will still look a lot like the Corvette Mako Shark II show car, but extremes in body lines have been smoothed over. The back window, for instance, will be one piece of clear glass, not covered by louver-like slats. Low front end and severely swept-up rear end—with air spoiler—are the major styling themes.

**The 1968 Shelby Cobra**, however, will carry a midship engine. The new Cobra will have a Ford 427-cu.-in. engine driving through a four-speed transmission, and it will probably be built in England. It will look much like the \$18,000 Ford GT Mark III—low, sleek, fast. If the price of this car is kept at Corvette level, you can look for Chevrolet to scramble their midship job into production sooner than in the three years now projected. Side note: Zora Arkus-Duntov, Corvette designer, is one of two owners of Ford GT40s that have been sold outside of the company. He had it out to the GM proving grounds for 10 days last summer running evaluation tests.

**Henry Ford II says his company** is going ahead with electric-car development "just as fast as we can." While no flat statement of time is given, most Detroit observers say the auto industry will be lucky to get an electric car on the road before 1975. Ford says the car they're working on is best suited to city and suburban

driving where short trips can be made without recharging the battery. An electric car that will duplicate the power, range, and refuelability of present engines is beyond the wildest dreams of electric-car scientists. But all this talk about electric cars has had a good effect. Scientists who have not worked with the auto companies before are interested, and their contributions may lead to the breakthrough Detroit claims it needs to make the electric car competitive with gas engines. One drawback in electric power that most people overlook is the emission problem, if fuel cells are used. Fuel cells can emit dangerous by-products that will contaminate the atmosphere as much as present-day combustion engines. But fuel cells are still a long way down the road. Before they're ready you'll probably be driving an electric car with a rechargeable battery—perhaps like Ford's sodium-sulfur battery or GM's silver-zinc.

**The new Lincoln Mark X** I told you about [Nov. '66] will be the first of the Lincoln line to get a separate frame and body chassis. It's still scheduled for introduction next January. Look for this car to be priced and sized right smack up against Cadillac's Eldorado. That means it will be a close-coupled car with shorter wheelbase than the 126 inches of the present Lincoln Continental.

**Air conditioning keeps getting hotter.** If the present trend continues, three out of every 10 new cars will be air-conditioned. Installations rose from 23.15 percent in 1965 to 28.92 percent in 1966. And the rise shows no sign of leveling off. The day may not be far off when A/C will become a delete option—you'll have to specify when you don't want it on your car. On '67 luxury cars, only one in five is built without air conditioning.

  
Detroit Editor



# Why does the "in crowd" go all out for The Round Tire?



Because  
it rolls  
at least  
3,000  
miles  
further!

Great performance is music to the ears of people in the know. That explains the enthusiasm for the Atlas PLYCRON®—The Round Tire.

You see, The Round Tire is made in a mold that's precisely engraved to within 3/1000 of an inch of perfect round. Other molds can be out of round as much as 30/1000 of an inch.

This near-perfect roundness is one of the many reasons why an Atlas PLYCRON Tire rolls more smoothly, wears more evenly.

**FOUR ACTUAL PLYES.** The Round Tire has 4-ply construction for greater strength plus many other marks of quality—a unique tread design which puts more rubber on the road—longer-

wearing tough rubber compounds. These are just a few of the many examples of the care that goes into building The Round Tire.

**SAFETY TESTED.** You'll be glad to know The Round Tire is also safety tested in 54 different ways. In addition, road tests were conducted on complete sets of tires from various manufacturers' production for 1967 cars and were promptly run under identical conditions by an independent test fleet.

These tests showed you can expect 3,000 more miles from The Round Tire than from tires that come on most new cars.

Get your extra miles with The Round Tire!

## ATLAS PLYCRON

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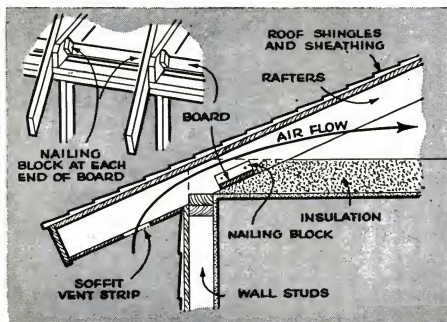
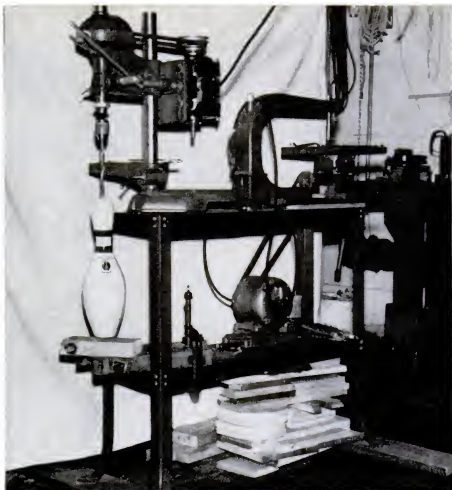
## SHORT CUTS AND TIPS

FROM PS READERS

### Making extra-deep holes with a drill press

With my drill press mounted at the end of my workstand and the head swung around, I can drill holes far deeper than the normal 3" capacity of the press would allow. This also works for drilling holes in long parts. The work rests on the floor or on a shelf extension and can be raised by blocking. Long drills are sold in hardware stores; or lengthen a conventional drill by squaring its shank for  $\frac{1}{4}$ " and sweating it into a hole drilled in the end of a steel rod of similar size and appropriate length.

R. H. WOLFF  
Franklin, Wis.



### Soffit air vent is kept clear by wood barrier

To keep thick batt insulation from blocking the air flow through a soffit venting system, nail a couple of spacer blocks to the sides of the rafters and fasten a board between them, as shown at left. This forms a shallow air space between the board and the roof sheathing. When the insulating batts are installed, the board stops them from fluffing up and expanding into the entire area between the plate and the roof.

V. H. LAMOY  
Upper Jay, N.Y.

### How to locate outlets behind paneling

When you install wall paneling, here's a sure way to locate electrical outlets without tedious measuring. Remove the outlet cover plate and outline the opening on the wall with paint. Then place the panel in the desired position and press it firmly against the painted area. When you remove the panel, the paint outline on the back gives you an accurate guide for cutting. Make the cut with a keyhole or saber saw.

H. MULLEN, Cleveland.

### Homemade wood filler dries rock-hard

A light-colored, fine-textured wood filler can be made by mixing white-pine sanding dust—not sawdust—into white glue. Stir thoroughly, using enough glue to form a thick paste. Fill holes and cracks slightly higher than the surface to compensate for shrinkage. After the patch has hardened, sand flush. The filler holds screws well, can be sawed, carved, or machined, and takes stain.

S. L. WALTON, White Plains, N.Y.



## Should you pay twice as much to get it washed?

A Volkswagen isn't any bigger than other station wagons...it just carries more.

That's because a station wagon shaped like a box can hold about twice as much as a station wagon shaped like a station wagon.

So it will cost you exactly the same to get it washed, but that's about all that will cost you exactly the same.

Our wagon gets around 23 miles to the gallon. You'll pay Volkswagen prices for parts. Some

35,000 miles should go by before you have to go buy new tires.

And come to think of it, maybe you should pay less for the wash job, too.

A Volkswagen is actually shorter than other station wagons. (It'll park in 4' less space.)

So next time, why not ask the man at the car wash for a discount.

Don't tell him we sent you.

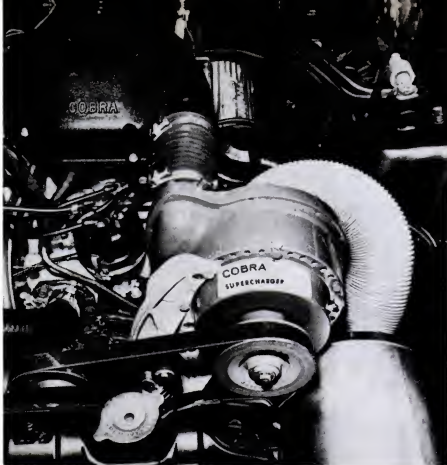


## WHAT'S NEW

### FOR YOUR CAR

#### An easy way to get more horses from a Ford V-8

Instead of tearing down an engine and starting over, you can bolt on extra power—with a supercharger. There's now a Cobra blower for the 289-cu.-in. Ford. Running with five pounds' boost, engine power goes up 46 percent. With special manifold and supercharger, the 289 has been dynamometer-tested at 388 hp. The kit costs \$435. Shelby American, 6501 W. Imperial Highway, Los Angeles 90009.



#### Driving light with quartz-iodine element

The Wipac driving and fog lights give a beam three times stronger than ordinary driving lights thanks to their quartz-iodine elements. These give long-range penetration without dazzle. The bulbs have a tungsten filament and traces of iodine vapor. When tungsten molecules are released from the filament they form volatile tungsten iodide, which does not condense on the hot bulb. For six- or 12-volt systems, \$22 a pair. J. C. Whitney & Co., 1917 Archer Ave., Chicago.

#### Pirelli tubeless radial-ply tire

Yes, it's designed for high-performance American cars and comes in five sizes—from 6.50 by 13 to 8.15 by 15. The CN72 is a belted radial-ply all-fabric tire, rated for speeds up to 150 m.p.h. In blackwall or with a narrow white-wall, from \$40 to \$54. Pirelli Sales, 60 E. 42 St., NYC 10017.



#### How to measure distances on road maps

The 12-scale Radix rolls over maps to measure statute miles, nautical miles, or kilometers, then marks a route with a built-in crayon. \$1. Wesley Woods, Box 661, Westwood, N.J. 07675.



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your vision.**



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your outlook, too.**

GM replacements look and act just like GM originals. That's because they're the same in every way.

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Go where they use Genuine GM Parts. They come in GM and United Delco packages and they're available just about everywhere. Besides, good parts are a sign of good service.

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# Bold, breezy youngster, fresh

Toledo? That's where 'Jeep' ruggedness comes from! Now it's built into a **bold new sportscar**. With bucket seats. Continental spare. Roll-up windows. If you like, add automatic top. Sports console. Hot new V-6 engine with automatic transmission.



All this... and 'Jeep' 4-wheel drive!



Jeepster Convertible



Jeepster Commando Station Wagon.

Power brakes, even air-conditioning.

And world-famous 'Jeep' 4-wheel drive is standard equipment! Testing is believ- ing. Test the safety and adventure of 'Jeep' 4-wheel drive. Climb a mountain. Blaze a trail. Holy Toledo, what a car!



# ut of Toledo! The Jeepster.

There's a whole family of Jeepsters to choose from... Convertible; Jeepster Commando Station Wagon; Jeepster Commando Pick-up; Jeepster Commando Roadster. Choice of colors, too.

Hop in and give the new Jeepster a test

drive. You've never handled a sportscar with the smooth ride and bold, brash performance of this one!

You've got to drive it to believe it. See your 'Jeep' dealer. Check the Yellow Pages.

**KAISER JEEP CORPORATION**  
TOLEDO 1, OHIO

**"Holy Toledo, what a car!"**



YES, YOU'RE RIGHT... THAT'S TOLEDO'S FAVORITE SON, DANNY THOMAS!

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*And...* **A 20' GLASSPAR  
COMMODORE CHARGER  
WITH A 120 HP MERCURISER  
INBOARD-OUTBOARD ENGINE**

WHERE WOULD YOU GO on your Blue Water Vacation? Imagine yourself basking in the sun by an azure sea, perhaps in Acapulco, or surfing in Hawaii, how about the Bahamas, Bermuda? Wouldn't a cruise on the Aegean be fun? Maybe you'd prefer the beach on the French Riviera? You can win a two week, all expense paid "Blue Water" trip for two anywhere in the world, and a 20' Glasspar boat.

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of superb  
Northland  
water skis



The rules are easy; simply drop into your nearest participating Glasspar dealer and fill out the free entry form. That's it; no obligations, nothing to buy. The winners will be selected in a random drawing. Hurry! Offer closes March 30, 1967.

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SHORT CUTS AND TIPS

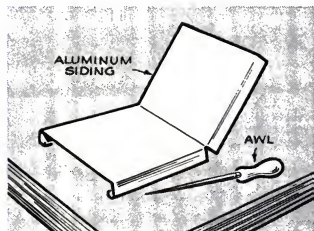
FROM PS READERS



## Palette knives from feeler gauges

Turn your discarded feeler gauges into palette knives or small spatulas. They can't be beat for spreading glue or spackling nail holes. Grind away the end of the leaf with the hole in it; taper the sides to a point. Put the leaf in a vise and tap on a length of dowel for a handle. The dowel should have a slit on one end to take the blade. You can select the stiffness you want by starting with a gauge of a particular thickness.

FRANK H. TOOKER, Pine Beach, N.J.



## Easy way to cut aluminum siding

Aluminum-siding cuts that are too long to tackle with metal snips can be made with the aid of a knife, awl, or scribe point. Score the metal deeply. Then bend it back and forth until it breaks along the score. Start bending at one end, and gradually work toward the other. Take care to avoid extreme bending, however, since it can cause kinks where you don't want them. This aluminum-cutting trick also comes in handy when you've misplaced your snippers or other cutting tool.

WALTER BURTON, Akron, Ohio



**If our new Firebird 400 is too much car for you,  
try our new Firebird HO,  
Firebird Sprint,  
Firebird 326,  
and Firebird. In that order.**

Taking on a Firebird 400 is awe-inspiring, even if you're prepared for what happens when you connect 400 chromed cubic inches to a heavy-duty 3-speed and couch it in special suspension.

(You can even order wide- or close-ratio 4-speed, 3-speed Turbo Hydra-Matic and our Ram Air hood-scoop air intake option!)

So we designed the Firebird HO. Our light heavyweight. Its 326 cubes lay out 285 hp in prolific abundance. Via four barrels. Dual exhausts announce its coming. A sassy sport stripe on each flank says: *It's here.*

Our Firebird Sprint is for people who've found Europe wanting. Features: 215-hp, 4-BBL Overhead Cam Six. Split manifold. Exotic exhaust note. 3-speed floor shift. Road-hugging sports suspension. Much arrogance.

Even our cool ones speak with authority:

Firebird 326 is a regular-gas, 250-hp V-8. And Firebird is a 165-hp Overhead Cam Six. All Firebirds have GM's standard safety package and road-gripping wide-oval tires.

Which Firebird is for you?

**The Magnificent Five are here!**



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## SHORT CUTS AND TIPS

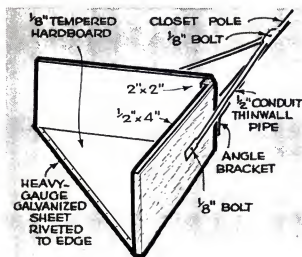
FROM PS READERS



### Watch serves as darkroom timer

I call this my "poor man's print-room timer." Just drill a hole in the plastic safelight filter and insert a hook to hang a pocket watch on. Epoxy the hook to the inside of the safelight so it won't pull out. I use this over my print-developing tray for rough timing. The watch is always illuminated, and it is close enough so that I can read it.

KARL J. KRAUSSE, Rockville, Md.



### Pusher eases snow-removal job

Being at an advanced age, I find it difficult to use a snow shovel. So I have made a pusher as shown here. This makes it much easier for me to clean away the snow.

R. W. PEDERSEN, Montevideo, Minn.



**Got kids who like action?**



**Got a wife who likes comfort?**



**Got a yan to go fishing?**



## ...GET A SPORTSMAN!

Some boats are soft riding. Some have stability. Some have style. Some are designed for fishing. Some for cruising. Some for skiing.

There's never been one boat that does all these things exceptionally well — until now.

If you like to fish, but don't like to abandon the wife and kids, The Sportsman is your kind of boat. It has more usable space than conventional boats 2 or 3 feet longer. It has comfortable bucket seats that unfold into sun lounges (if the fish aren't biting, just relax).

The floor is flat. There's a casting platform forward where the pointed bow would be if it had one. The split windshield folds to provide

easy access to the foredeck. You can beach the boat and step off without getting your feet wet. And you can button it up with its tonneau cover to make it look like a runabout.

The Sportsman has all the sea-going characteristics that distinguish Evinrude's wide-track Gull Wing hull. You ride on a cushion of spray. It's soft, stable, dry.

It's the kind of boat that'll get you to where the fishing action is in a hurry—and in solid comfort. It does it quietly, smoothly, economically—with a choice of 90 hp V-4, 120 hp inline-4, or 155 hp V-6.

The more you know about boats, the more you'll appreciate what the Sportsman does for a fisherman — and his family.

See the Sportsman at your Evinrude dealer, listed in the Yellow Pages under "Outboard Motors." Catalog free. Write Evinrude Motors, 4067 N. 27th St., Milwaukee, Wis. 53216.

**EVINRUDE**  
first in  outboards  
Div. of Outboard Marine Corp.



## I, shy, sly Sylvie Shaw, am a flavor grabber.

How could this happen to a nice girl like me?

Blame it on that cute Mr. Finney in accounting. You know. Wavy hair. Blue eyes. Always smoking L & M cigarettes.

Well, one day while passing Mr. Finney's desk, I grab one of his L & M's. It's good! Not sharp. Not flat. But a good round flavor you don't get in any other filter cigarette.

Later, I grab another one!

I, Sylvie Shaw, am a flavor grabber. My conscience pangs. I run down and buy my own L & M's. I figure, and rightly, when you grab hold of an L & M, you grab hold of flavor.

Now my L & M's are missing. Could that sweet, friendly Muriel Robbins in research be a flavor grabber?

## Auto Racing Around the World

By JAN P. NORBYE  
PS Automotive Editor

Auto racing is running ahead of baseball in numbers of paying spectators per year. All over the world, cars of different types race on all kinds of roads and tracks. On these six pages, the top drivers in five different forms of auto

racing give you their views on the sport. To give you vivid illustrations of what they are talking about, we also bring you the pick of the 1966 season's color photos by Julius Weitmann, Joe Farkas, Stanley Rosenthal, David Phipps, and André Martin.

### *The best racing: Grand Prix*

By JACK BRABHAM

World Champion GP Driver  
1959, 1960, and 1966

**T**he greatest moment in my racing career? I think it was when I won the German Grand Prix one rainy day last summer. This race is run on the Nürburgring in the Eifel mountains — a 14.5-mile course with 176 turns per lap, left and right. The altitude difference between its highest and lowest points is 2,400 feet. It was a close race and I needed all my skill and experience to stay in front. The moment of victory clinched the World Championship for me, but I'll remember the race itself and the satisfaction I got from driving my car to its absolute maximum, when the title is fading from memory.

There is nothing like Grand Prix racing. A Grand Prix car is made for the single purpose of going fast around a road course, across hills and dales, dips and rises, and crests where the cars make long leaps in the air. This is a greater challenge than racing on oval tracks. I know something about it. I started out in dirt-track racing in Australia, and I have raced at Indianapolis.

Grand Prix drivers are the best in the world. They have graduated to Grand Prix from other types of racing. We race against each other throughout the season. We trust each other, even heading into a turn wheel-to-wheel at 180 m.p.h. We have a lot of written rules and some unwritten ones. We live by them and are proud of it. *Continued*



Jack Brabham drives a Brabham — a car of his own construction with an Oldsmobile-based Repco V-8. Below, John Surtees (Ferrari) leads at Monaco, chased by Jackie Stewart and Graham Hill (BRM).





A terrific duel raged in the early stages of last year's Indy 500 between Jackie Stewart's Lola-Ford (43) and Roger McCluskey's Eagle-Ford (8).



**By MARIO ANDRETTI**  
USAC National Champion 1965 and 1966

## Indy—

**I**ndianapolis—it was the only American race I had ever heard of when I first started auto racing back in Italy. By 1964 I had made it to Indy myself. I finished third in '65 but I won enough other races to get the USAC championship that year. We use our Indy cars for a number of other races, such as at Milwaukee, Trenton, Phoenix, and so on, and I get the points winner at the end of the season.

But back to Indy. It's a great race. It's a race you talk about all year. Car builders, mechanics, sponsors, drivers—they all work towards that one day in May the whole rest of the year. And think of that huge crowd!



## where the big money is

Indy is big game for the drivers. Prize money is the highest in the world. They also have special lap prizes for the driver who's in front at any lap. Last year I was leading with my Ford engine running on only seven cylinders. The engine was going to break up sooner or later, but I decided the extra prize money would be worth it. I held the lead for 17 laps before the engine quit.

British drivers have won the last two 500-mile races at Indy. I'm glad to see them come to Indy, for they add a bit of extra rivalry between drivers, and an international flavor. It's been said they're better drivers. Well, time will tell.

*Continued*

Ford-powered Lotus cars have an enviable record at Indy with a win in '65, second place in '66. Both years, Scotsman Jim Clark was the driver.



# Why I like sports-car racing



By  
**BRUCE  
McLAREN**

Le Mans  
Winner 1966

**M**y win at Le Mans last June, shared with Chris Amon, naturally gave me a big kick. But this 24-hour endurance is not all fun. It's tough. Toughest part is the classic sprint-start across the road into the cars. This start may be a wonderful spectacle for the crowd, but for the drivers it's nerve-shattering. Tension becomes agonizing during the last few minutes before the four p.m. start.

I really enjoy the first few laps around the eight-mile Sarthe road circuit in France. Then you're fresh and exhilarated, and battling with the top boys for the lead. It's

terrific to push the big 470-hp. Ford GT up to 215 m.p.h. on the three-mile-long Mulsanne straight.

It usually rains at night at Le Mans. First you slow down because of darkness. On a wet track you trim the speed further. Peering bug-eyed through the plumes of spray trailed by the cars ahead is no joke.

What does it take to win? Natural ability and experience count for a lot in sports-car driving. You need determination and dedication. You need competitive spirit and a real will to win.

Concentration comes next. Single-mindedness is needed to hold that fine balance between going as quickly as possible and still having something in reserve. Long-distance racing takes plenty out of the car as well as the driver, more than a two-hour Grand Prix.

So you hold back a little to save your engine, transmission, and brakes. At Le Mans last year, our Ford had to hold out for over 3,000 miles to win. We averaged 125.4 m.p.h.

## My kind of racing... stock cars



By **DAVID PEARSON**

NASCAR National Champion 1966

**I**n stock-car racing, pitwork is sometimes just as important as the driving. The Wood brothers proved this a couple of years back in stock-car racing and again to the Indy crowd when they pitted Jimmy Clark into the winner's circle in 1965.

The Cotton Owens crew that prepares my Dodge can change two tires and give me 22

gallons of gasoline in 20 to 22 seconds. No one can beat them. They really won some of the 15 races last season that gave me the NASCAR championship.

I feel that stock-car racing offers a variety of challenge equal to road racing, and maybe more. On the NASCAR circuit there are many different racing situations. And stock cars have proved they can run in road-course events. The driving is completely different at each race track. And you don't set up the car the same for a quarter-mile track as you would for the Daytona Speedway where you run up to 180 m.p.h.

At Daytona, the ability to "draft" (ride in another car's slipstream to gain speed and conserve fuel) can make all the difference. Broadsliding on the dirt track in Spartanburg is a necessary talent. Laying your car on the guard rail to come off of the third turn at Darlington — and gain your "Darlington Stripe" — is another necessary skill.



The oldest sports-car race held annually is Sicily's Targa Florio, which was first run in 1906. Above, Mauro Bianchi's Alfa Romeo.



McLaren presses on to victory at Le Mans (above, right) despite teeming rain. The Ford GT ran impeccably to win at record speed.



Ravetto's Ferrari GTO keeps in front of Linge's Porsche (right) as the road leaves the Mediterranean and heads for the mountains.

Parnelli Jones with a hemi-powered Plymouth Satellite GTX leads the Mid-America 200-mile race at Wentzville, Mo., not far from St. Louis. Chasing him is Don White in a Dodge Charger. This is one of the road circuits where stock cars compete regularly.

Dick Petty's blue Plymouth leads the field in the National 500 at Charlotte, N. C. This is one of the season's main events — 500 miles on a superspeedway. Yarborough won, Petty retired, Pearson was 10th.





Guy Verrier hurries through the French Alps on his way to Monte Carlo with a Citroën DS-21.



Paddy Hopkirk rushes his Mini-Cooper around a turn in Holland's Tulip Rally. He won the Monte Carlo Rally with a similar car in '65.



Swedish champion Erik Carlsson plows some mud with his Saab in the African Safari Rally. All three cars on this page have front drive.

## Road rallies: agony and ecstasy

By **PADDY HOPKIRK**

Rally Team Member, British Motor Corp.

**I**n Europe, Africa, South America, and Australia, rally driving is race-driving on open roads. You've got to be born with some sort of gift for this sport. Then it takes experience to develop your judgment, sense of timing, and "feel" for motor cars into a precise skill. Mental attitude is important! Easy-going self-confidence is what's needed.

Anticipation is a big thing. And that's what makes a good rally driver a really good motorist. You're driving at close to full bore on roads you don't know, but always allowing for the unexpected around each corner.

Professional rallying is an expensive sport and big business for the auto makers. The cars are virtually standard production models, and a win gets big publicity. As an extra bonus, a tough grind through mountains and snow, deserts and sand, probes out weaknesses in a car that cannot be found any other way. I think the rally team pays its way in engineering development.

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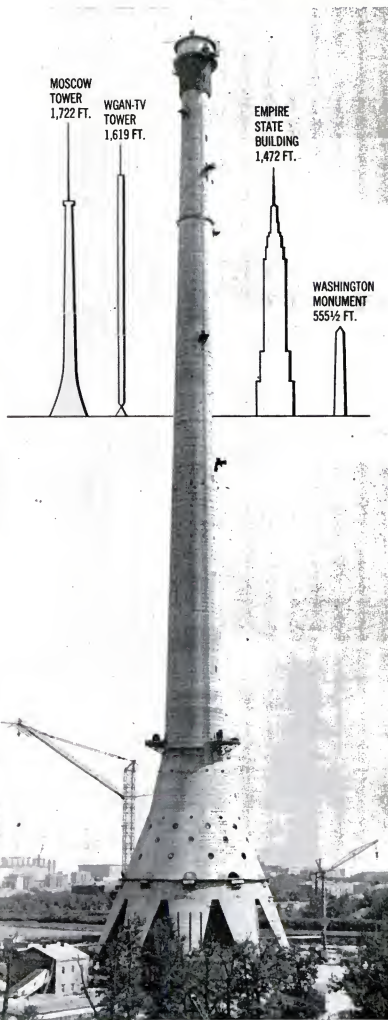
## Russian TV tower will be world's tallest structure

When this 1,260-foot concrete TV tower in Moscow gets its 462-foot antenna, it will stand as the world's tallest structure at 1,722 feet—just about 100 feet higher than the WGAN TV tower in Chicago, now holding the height record. The new Russian TV tower will also dwarf other well-known giants, shown in the drawing at right. The tower is 196 feet across at the base and tapers to 26½ feet at the top. It has built-in sway to withstand winds up to 141 m.p.h.



## Storage bag is a life preserver

The new inflatable storage bag shown above will hold all your valuables when you're out boating; it also can help keep you afloat if you're swept overboard during a storm. Its triple-fold, snap-closing design makes the Aqua-Safe watertight. When inflated, the bag also makes a comfortable boat cushion, or even something to take along to sit on when you're watching a ball game. The 19½-by-24-inch accessory costs \$10. Kayak Corp. of America, 7 E. 38 St., NYC.



What's the truth about flying saucers? Here, in a "white paper" for Popular Science, the eminent author and authority in the fields of science and psychology discusses the pros and cons

**PS EXCLUSIVE**

# **UFOs: The Sense and the Nonsense**

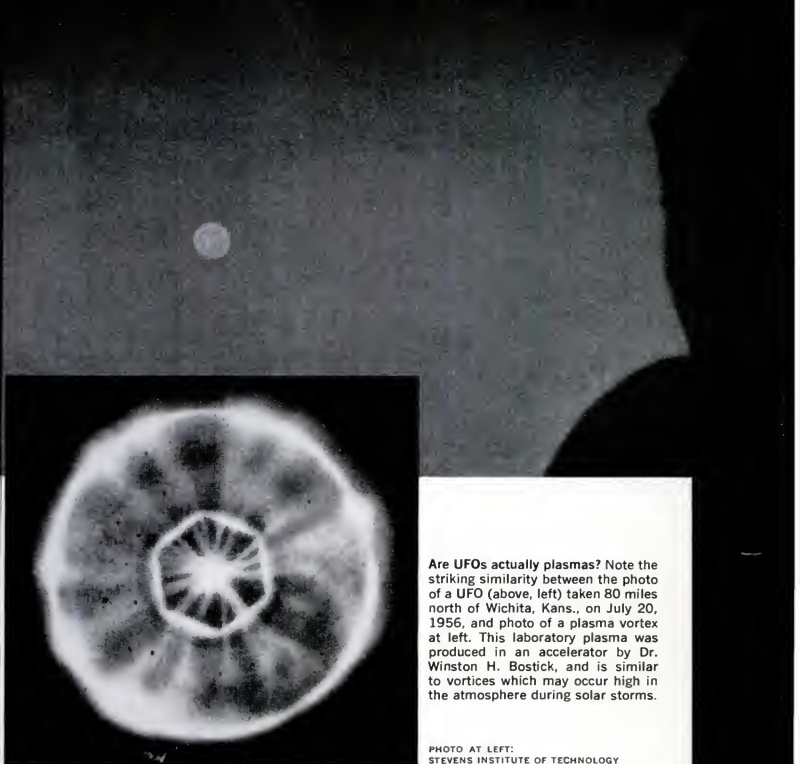
**By PHILIP WYLIE**



*Philip Gordon Wylie has been writing books and magazine articles touching on almost every scientific subject since 1925. Among his recent works are **They Both Were Naked, Tomorrow!**, **Triumph**, and a new edition of his famous classic, **Generation of Vipers**.*

**N**ow that the University of Colorado has been engaged to study flying saucers, it is possible to think of them in a new way: scientifically. A large group of scientists in all fields has been assembled to work under the direction of Dr. Edward U. Condon, professor of physics at Colorado, in a definitive research project on unidentified flying objects.

Few scientists have ever been tested by public ordeal and proven as fair-minded and steadfast as Dr. Condon, former head of the U. S. National Bureau of Standards.



Are UFOs actually plasmas? Note the striking similarity between the photo of a UFO (above, left) taken 80 miles north of Wichita, Kans., on July 20, 1956, and photo of a plasma vortex at left. This laboratory plasma was produced in an accelerator by Dr. Winston H. Bostick, and is similar to vortices which may occur high in the atmosphere during solar storms.

PHOTO AT LEFT:  
STEVENS INSTITUTE OF TECHNOLOGY

It will simply not be sensible to doubt the findings of the men currently engaged in this study. I believe I can make an educated guess as to what their findings will be.

In the past 20 years, I have been intimately associated with hundreds of scientists of many disciplines on projects in areas as diverse as biology, psychology, nuclear weapons, defense matters, ecology, and others. During that time I have heard perhaps a hundred or more leading scientists discuss UFOs. Their thoughts give

me a base for this article—it represents an informal consensus, not an individual opinion.

First, it is evident that some unidentified flying objects may involve little-known or even unknown principles. And it is conceivable, though unlikely, that this planet might be visited by intelligent beings from another. Thus, the question is twofold: What is the nature of UFOs sighted but not explained? Second, are any of the reported sightings evidence that alien beings are reaching earth?

*Continued*

# Is there a conspiracy to "hush up

To take up the first question, all the evidence of such vehicles is of a hearsay nature, or of a secondary sort. Not one single solid item of tangible proof exists. The best photographs are no more credible as evidence than the verbal reports of the most reliable persons.

Until the research was turned over to a university, with no holds barred, some people, convinced of earth visitations, were able to cling to the unsupported premise that the Air Force, or the Pentagon, or the CIA, or somebody in federal government, knew saucers existed and was hiding the evidence. That sort of thinking isn't tenable under the new setup.

## Believing the improbable

As it examines the statements and pictures, the new scientific group will conclude that the great majority of vehicles reported, and tales of trips in them or of meetings with their operators, along with mere sightings of what were held to be mind-guided spaceships, are just not credible.

Why?

To believe them, in general, would be to believe several improbable things. It would mean that in the past 20 years, all of a sudden as time and history go, the inhabitants of some distant world have been coming here in scores of different model spaceships. Either that or, equally suddenly, beings from several scores of distant planets have arrived here virtually at the same moment. The variety of "things" reported leads to one conclusion or the other.

We are also required to believe that these vehicles are solid and even peopled, despite the fact that the thousands of professional (and trained amateur) astronomers who ceaselessly watch the sky have not seen even one!

Not one saucer has been registered, either, by the enormous numbers of delicate instruments that watch for enemy planes and missiles; or by the arrays of instruments on satellites; or by the instruments that keep track of every trivial body in orbit—large or small—where men placed it or left it as junk.

That means, to the scientist, that only one or two saucer sightings at most can even imaginably be reckoned as of extraterrestrial origin and as intelligence-guided. Likely, none at all.

## Are plasmas the answer?

In a recent article in *The Saturday Evening Post*, Dr. J. Allen Hynek, an astronomer and for 18 years the lone scientist consultant to the Air Force program Project Blue Book, says that, though most "sightings" have been shown to be errors of identity, fraud, and so on, not a few, made by reliable people, have left him perplexed.

Of the examples he cites, most, I feel sure, would not seem so baffling to a physicist familiar with the behavior of plasmas.

Just such a man, Dr. Philip J. Klass, writing in *Aviation Week & Space Technology*, describes plasmas of varied sorts that satisfy many of the perplexities Dr. Hynek speaks of: the glows, colors, repulsion from chase planes, speeds, antic motions, inverse shapes and light intensities, appearance on radar, and so on. He also provides plasma photographs more saucer-like than pictures of alleged UFOs.

Plasmas are an electrical phenomenon not entirely understood. But, having closely observed two examples in the form of ball lightning, I can say that both might easily have been taken for flying saucers, even by highly competent and completely honest observers. They certainly looked and acted like nothing else on earth. The Colorado investigation may, in consequence, add to plasma science as well as to our knowledge of odd mirages, deformed weather balloons, swamp gas, and bizarre atmospheric events.

## Those unintelligent aliens

What evidence do we have that UFOs are guided by intelligent aliens? The alleged operators of the reported saucers have never yet demonstrated any intelligence. What they "do," if we are to believe current reports, is not intelligent. They buzz cars, planes, and people. They allegedly give rides to scientifically unqualified people. Or they make "physical examinations" of admittedly emotionally disturbed persons.

What they do not do is even more significant. They do not try to communicate persistently, or with any group of specialists who might be capable of receiving communication. They leave no unmistakable evidence of landings, no indisputable evidence that they have sampled anything or

# The truth about flying saucers?

destroyed anything, or left anything behind. In the more specific of their reported acts, their behavior parallels that of pranking kids—not of beings who had the wit, skill, resources, and scientific prowess to undertake a billion-billion-mile journey using some propulsion technique so advanced as to be totally beyond the state of the art as we know it.

The only response to such observations is that human logic cannot understand the (logical) behavior of alien minds.

That suggestion, typical of much of the supportive ideology of saucer believers, is self-defeating. If what saucers are reported to do is "logical" in some way incomprehensible to human imagination and reason, then there is no use paying any attention to saucers even if they do exist, since, in that case, nothing about them is apt to make sense to mankind. If you define a being as "incomprehensible"—well, it is.

Finally, the psychologists will enter their objections. They will show that many people are reluctant to believe in saucers guided by intelligent aliens because they think that, in this dangerous H-bomb era, man needs outside help to be saved from himself. Such frantic wishing is father to all sorts of delusions and limitless misconstructions of sense perceptions.

The psychologists will note the universal tendency of people, when confronted by the startling, the unknown, the incredible, the fantastic, or what seems such, to flunk in accurate reporting. No two witnesses of even one such event will relate it identically. On the contrary, 50 persons will give 50 reports, all different and contradictory.

The power of suggestion and of mass hysteria will be cited in this connection, too. A recent balloon-fusee saucer hoax, by Yale students, not only elicited thousands of differing reports of the same thing, but set off all Los Angeles on a massive if incredulous stampede. Excited beholders and mass suggestion resulted in a million virtual hallucinations about what was, really, a small, slow, floating thing with a crimson glow in the night sky.

## The government hush-up myth

Many claims by the believers are appalling. Some of them attribute to our government such chicanery, lying, secretive-

ness, and untrustworthiness that the people who make the libel should be obliged to come up with proof. If the United States were really as deceitful as they claim, it would be time for every citizen not to believe in saucers, but to do something direct about the catastrophic condition of America.

Should such an epochal event as a saucer landing occur, news of it would be unmistakably the property of all men, not the secret of any one nation. To keep it secret would risk a second visit to another, less stupid nation, which then would get a "first" in the tremendous announcement. To keep such a thing secret would also, logically, annoy the beings "back home" from where the impounded (we must assume) voyagers came.

They, being by definition technically far ahead of us, would surely take steps to see what happened to their explorers. Maybe very violent steps.

Yet all the "saucers-are-real" books and articles I have read, including the works of Major Donald E. Kehoe, Frank Edwards, the recent book, *Incident at Exeter* by John G. Fuller, and a half-dozen others, have had to take that negative premise of "government secrecy" to seem even sensible. By far the best book on the subject, in my opinion, is *We Are Not Alone*, by Walter Sullivan, Science Editor of *The New York Times*. He gives most of the relevant factual information without being any more saucer-eyed than the large number of scientists now at work under the University of Colorado's Dr. Condon.

## Comet pills and saucers

I know people who say they've seen the Indian rope trick. I also know a number of well-educated Indians, and none of them ever saw the trick or knew anybody in India who had seen it. I can remember the last appearance of Halley's comet, too. Millions then thought the earth, due to go through the comet's tail, was doomed. Myriads bought "comet pills" alleged to be antidotes for the "poisons" in the tail. And many newspapers this very day publish astrological tables and horoscopes (as well as reports of flying saucers), because millions of us believe that stuff, too.

For what I believe, though, I want evidence. The scientific kind.

ES



Like spiders in a web, construction workers swarm over steel pipes that frame a gigantic geodesic dome.

## U.S. builds a skybreak bubble for



Twenty stories high and 250 feet in diameter, the airy bubble will house scientific and cultural exhibits.

The U.S. pavilion at Expo '67, the Montreal World's Fair, is a 200-foot-high bubble—the largest geodesic dome ever built. Designed by the famed architect R. Buckminster Fuller, the dome is 250 feet in diameter and will enclose 6,700,000 cubic feet. Incredibly, only 27 ounces of construction material are needed to enclose each cubic foot of space. The dome weighs about 1,615,000 pounds.

The frame is made of 27 miles of steel pipe, held together by 53,274 pieces in all—held together by 53 asterisk-shaped steel hubs. Metalized Mylar sunshades mounted on spring-loaded rollers cover your window shades cover the framework. Triangular plastic sheets within each hexagonal unit, constructed according to Fuller's patent.



Close-up look shows the hexagonal shape of each unit of the dome. Six triangular, tinted-plastic shades

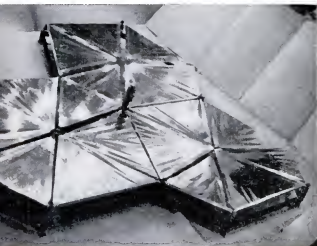


Expo '67. Dome will be United States pavilion.

## Montreal fair

Mathematical equations, form the shades. These are automatically controlled by 260 electric motors. Each motor pulls sets of cables to roll or unroll the tinted plastic, depending on the sun's brightness. When the shades are fully unrolled, the sun's rays will vary the appearance of the bubble's skin—from transparency to a sort of polished chrome, depending on the angles of the rays.

The U.S. pavilion will be one of more than 100 buildings representing some 70 foreign countries, Canadian provinces, and industrial exhibitors at the Expo '67 site in Montreal. The fair, which will celebrate Canada's centennial, opens on April 28th and will run for 183 days, until October 27th.

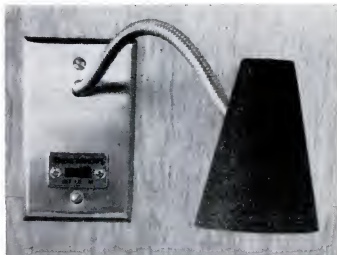


Open and close to shield visitors from the sun.



## Antitank missile for infantrymen

The Army is testing a super bazooka. The TOW wire-guided missile is reportedly able to knock out a tank when fired by infantrymen more than a mile away. After launching the missile, the gunner keeps his sight centered on the target, and the missile homes in electronically. Hughes Aircraft, developer of the missile, is working on a helicopter-mounted model.



## High-intensity lamp is wall mounted

This handy little light thrower, made by the Tensor Corp., is the first high-intensity lamp for wall-mounting. A gooseneck lets you focus it over any table or workbench, yet it won't get in the way of the work and it can't be knocked over. It has a high-low switch and costs \$12.95.



# How You Can Be an Expert Night

After dark, with the roads almost empty, you can cover more miles, relaxed and in safety—if you know the rules

By **PAUL W. KEARNEY**  
ILLUSTRATED BY HERB MOTT

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**H**ow would you like to drive highways:

- Relatively free of traffic?
- Under conditions tailor-made for keeping track of other cars on the road?
- Where you can clip off 600 miles a day with less strain—if you have the skill and know-how—than you normally experience?

Then consider the advantages of driving



# driver

after dark. Am I kidding? No, I'm not. I'm talking about driving at night, and I'm going to tell you how to do it.

Most of the bugaboos associated with night driving are products of ignorance. Sure, there are hazards. There are hazards to driving by day, too. Sure, night driving is tougher than day driving—but only if

you make it so, and for different reasons.

Few motorists take the trouble to learn the rules of safe driving after sunset. Few realize the advantages—the crest of that hill ahead can bring on an emergency in daytime, but at night an oncoming car announces its presence in advance with a halo of light.

The pleasures of night driving are manifold. Traffic is lighter. By day a speeding motorist zips by in that lane to the left, passing you, unheralded. I've had the wits scared out of me by a shape taking sudden form at the tail of my left eye. By night a car preparing to pass on the left tells me of its presence many car lengths in advance.

But perhaps the biggest pleasure of all—at least for me—in night driving is the exercise of skills that I have acquired by practice. These are a source of pride and also of reassurance. All of us, like it or not, are forced into a certain amount of night driving.

Do you know how to judge precisely the m.p.h. of those two tail lights ahead of you before you pull out to pass? I'm going to tell you. Do you know why you should smoke sparingly? I'll tell you. Do you know why it's a good idea to don dark glasses—at night, mind you—at coffee and gas stops? I'll tell you.

To back up my own tips and recommendations on night driving, I went to outstanding authorities in the field—the National Safety Council; Indiana University's Division of Optometry; champion driver Mario Andretti; Dennis Koelmel, the Sports Car Club of America's national rally champion; the Better Vision Institute; the American Optometric Association; the Society of Automotive Engineers; and an engineering administrator at the General Motors Proving Ground.

## Why you need special techniques

The main ingredients of safe night driving are implicit in the emphasis placed by experts on seeing and being seen—it's good vision and good lighting.

Your eyes don't easily night-adapt. It takes 45 minutes for the average eye to become completely night-conditioned. Man's night vision is about one-sixth of his day vision in acuity and one-seventh in contrast (the ability to distinguish one object from another). To man's eyes, all objects at

*Continued*

## Important in night driving: Keep all glass spotlessly clean

night are black or gray—colors and contrast disappear.

Your depth perception and your judgment of distance and speed—vital to good driving—are not as good at night. Precious few motorists have perfect vision, designated 20/20 by the medical profession. A grade of 20/40 in either eye is sufficient in 37 states to obtain a driver's license. A 20/40 motorist can recognize a letter of the alphabet about three-quarters of an inch high at 20 feet—in broad daylight. As much as 10 times more light may be required by a 20/40 driver to see properly at night than that required by a 20/20 man.

### What you can do about your car

You can be an expert night driver and, within the limitations imposed by less competent drivers around you, stay out of trouble. Some of what I am going to put down here may seem like kindergarten stuff. It is. And you would be surprised at how few motorists practice these simple precautions against accident.

Let's start with your car. Consider lights. You must be able to see other drivers and other drivers must be able to see you. You start with a handicap. State laws limit a headlight to 75,000 candlepower. One lighting engineer comments: "If the daytime illumination in your living room were equal to the output of a pair of 75,000 candlepower headlamps, you'd turn on the room lights to see better."

Have your headlights perfectly aligned by a shop equipped for the purpose. Your high beams lose a third of their effectiveness if they are off as little as a half-degree. Keep them clean. Dirty lenses can cut light emission by half. Keep tail lights, backup lights, turn-signal lights, and any accessory-light lenses equally clean.

Your windshield should be spotless inside and out. Make sure that it is wiped off at gas stops. Clean it yourself at coffee stops. Clean the *inside* surface—few drivers ever bother to do it. An aerosol glass cleaner simplifies the job. Use a lintless cloth or facial tissues for wiping. Don't use paper

towels—their harsh fibers leave minute, invisible scratches that cut visibility. A clean back window and side windows, inside and out, are only a little less important. Outside and inside rear-vision mirrors should be spotlessly, gleaming clean.

Spurn tinted windshields. A tinted windshield slashes night visibility 30 percent.



Reflections from surfaces on your car can be reduced if the cowl is black and the windshield-wiper arms are black-taped or painted a flat black. Be absolutely sure you have no leaks in your exhaust system.

Carbon monoxide seeping into your car can make you drowsy.

Make sure your wipers sweep clean. Fill the windshield-washer reservoir with clean water. In winter add a prescribed antifreeze to it—squinting untreated water onto a cold windshield in freezing weather is an invitation to trouble. A day-night rear-vision mirror cuts down glare from following cars. Carry flares for emergency stops—naturally, always off the pavement. If your car doesn't have four-way distress flashers, it can easily be wired for them.

Auxiliary, long-range driving lights, such as the quartz-iodine variety, can be of special help on secondary roads. The experts differ on the worth of so-called fog lights, but they are unanimous that any auxiliary lights must be positioned low, beneath the front bumper, to minimize scatter-kickback—a diffused glare.

In severe fog, masking over the top half of your sealed beams will reduce kickback glare. An expedient used in European road rallies is black-taping the low-beam part of the lens in the form of a square Greek cross.

In night driving as in day driving, your



## Windshield, rear-vision mirror, windows, your eyeglasses

most-used safety control is your brake pedal. Determine by test what the braking distance of your car is from your customary top nighttime speed—not what the braking tables say it should be.

Most headlights on high beam provide vision for good eyes up to 275 feet. Average brakes require 366 feet to halt a car from 60 m.p.h., including reaction time, on dry pavement. So don't overdrive your headlights.

### What you can do about yourself

If you have difficulty seeing at night, get a checkup. What's your rating? Drive accordingly. For each increase of 10 m.p.h. in speed, eyes sacrifice 20 feet of perception distance at night. If you can see 275 feet at 30 m.p.h., you can see only 235 at 50 m.p.h.

If you wear eyeglasses, keep them as clean as your windshield and headlights. You may benefit from special night-driving prescription lenses, which are ground slightly stronger.

If you are going to do any extensive night driving, wear low-transmission sunglasses—available at your eye doctor's—in brilliant sunlight. These conserve the eye's visual purple, a substance essential to night vision. Many a motorist has driven home night-blind after a day at the beach.

At coffee and fuel stops at night don dark glasses. This helps conserve the eye's night adaptation and its recovery rate from stabs of oncoming headlights. Remove your dark glasses when you reenter your car. In rejoining traffic from lighted areas, drive moderately until you are sure of your vision.

Lower your sun visor at twilight—your eyes' irises respond to the maximum light source like an automatic camera. Dim your panel lights. Sit high in your seat, on a cushion if necessary, for maximum visibility.

Look to the side of oncoming headlights. Close one eye, or squint. I squint. The light shock your eyes receive impairs your vision for at least seven seconds—while, at 50 m.p.h., your car travels 510 feet.

Flick on your brights the moment the other car is abreast.

Drive by looking at least four car lengths ahead and at the center of the road—sitting left, you tend to wander left at night.

Don't wait until you're tired to stop and rest. Plan coffee stops at least every two hours. If, between times, your eyes get tired, pull off the road then and there and rest.

Don't look directly at a dim object to see it, but just to the side of it—this is a peculiarity of man's night vision.

Keep your eyes moving. A fixed stare is hypnotic.

### What you can do about your personal habits and driving habits

Slice 10 m.p.h. off your normal daytime speed. From 50 m.p.h.—under perfect conditions—you can stop in 243 feet.

Smoke little if at all. Smoke fogs the windshield—and eyeglasses. Worse, the oxygen deficiency in the lungs from smoking three cigarettes in an unventilated car is equivalent to that at an altitude of 7,500 feet.

Keep your car well ventilated. In cold weather be slightly chilly rather than comfortably warm.

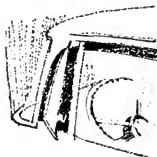
Turn on your low beams at dusk so other motorists can see you.

Because your eye cannot judge relative speeds at night as it does by day, you have to use subterfuges to get information from it. If, for instance, you want to pass on a two-laner, you can get the speed of the car ahead by slowing to its speed and reading your own speedometer.

Watch for those halos above hill crests. They announce oncoming cars. So do reflections of lights on telephone wires.

For your own safety and that of your fellow motorists, be courteous. Flash your brights to announce your intention to pass. Use low beam in following to spare the eyes of the guy in front. Press low beam a thousand feet before meeting a car in the opposite lane.

Observe all the foregoing precautions, do unto others as you would be done by, and number yourself among the "pros." P 5



# How We'll Bring Spacemen



**Gliding parachutes and rocket brakes, now being developed for U.S. manned spacecraft, will enable astronauts to make soft landings on the ground instead of splashing into sea**

**By DR. WERNHER VON BRAUN**

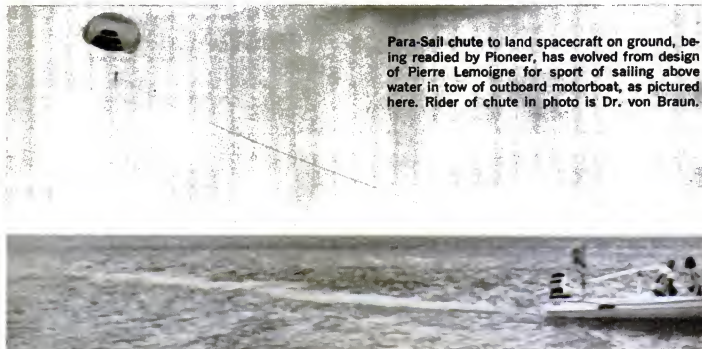
Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala., and author of the new book, *Space Frontier*

**I**n the not-too-distant future, Apollo and other U.S. manned spacecraft will descend safely on land as well as on water. Steerable parachutes, small retrorockets, and crushable impact absorbers will enable our astronauts to come down at any number of preselected places on the ground—without giving up their ability to splash down in the ocean.

This will greatly enhance the safety and flexibility of our manned space-flight operations. As we set our aims higher, it becomes increasingly difficult to limit permissible landings to a few ocean areas. More landing options will facilitate a return from an orbit over the poles, or reentry at superorbital speed from a voyage to the moon.

The idea of land landings is, of course, not new. Ever since Yuri Gagarin returned from the world's first manned space flight, all Soviet cosmonauts have landed their craft on dry land. In contrast, all our own manned space flights have ended with a splash in the sea and recovery by ship.

**Why did the two nations' landing schemes differ?** Look at a world map and you will see that while the Soviet Union has plenty of land, most of her surrounding waters are cold



**Para-Sail chute to land spacecraft on ground, being readied by Pioneer, has evolved from design of Pierre Lemoigne for sport of sailing above water in tow of outboard motorboat, as pictured here. Rider of chute in photo is Dr. von Braun.**

# Down on Land

and hostile—posing great danger to a spacecraft crew unless it can be recovered within a few hours. The only friendlier bodies of water are the Black and Caspian seas and, in summer months at least, the Baltic.

The U.S. has vast land areas, too—but those inhabited sparsely enough for landings are either mountainous, or deserts with blazing summer temperatures, or prairies with winter ice and snow. However, except for rare hurricanes, weather and sea state are pleasant all year round in a vast ocean area north of the Bahamas. So the choice of water landings for the first phase of our manned space-flight program, when pinpoint landings still had to be demonstrated, was an obvious one.

Water landings east of Cape Kennedy had another advantage. If a booster had given signs of failing, in any of our Mercury or Gemini launches, the astronauts would have immediately made an emergency landing some hundreds of miles downrange from the Cape. So our recovery ships were in an ideal standby position to aid the astronauts at splashdown—either from orbit as planned or from an abort during ascent.

USSR manned space flights have not enjoyed this advantage. Their rockets' north-easterly path, from the Soviet space center at Tyura Tam, leads across eastern Siberia. An emergency abort into those frozen wastelands could be fatal if lack of landing spots, or inclement weather, prevented immediate rescue by helicopter. This may well be one of the reasons the Soviets so far have never conducted a manned space flight during the winter.

**Pinpoint landings—with limitations.** Since the early Mercury flights, our astronauts' landing capability has been so refined that splashing down within sight of the recovery ship has become almost routine Gemini practice. But even so, as soon as parachutes were deployed, Gemini descents were no longer controllable.

For land landings this could have been a major hazard. A spacecraft drifts with the wind. Astronauts would be unable to see the landing spot—and even if they could see it, could not evade local obstacles on the



**Cloverleaf parachute**, developed for NASA by Northrop, lowers 2½-ton dummy capsule in ground-landing test. Controllable flaps enable chute to glide nearly two feet forward for every foot downward.



**Rocket brake**, triggered when probe touches earth two feet below, will ease capsule to soft landing. Photo shows solid-propellant Skirt Jet brake stopping fall of ½-ton test vehicle in Northrop trial.

ground. Unless they were lucky enough to touch down in tight underbrush or in a swamp, the shock of impact felt in a Gemini couch would have been excessive. Had the spacecraft come down on a steep slope, it might even have rolled down the hill—a dangerous and absurd ending for a glorious space mission.

[Continued on page 206](#)



Pyramid of Chephren looms beyond Sphinx—whose face is believed portrait of Chephren himself.

# Atom Sleuths Seek Secret Treasures in the Pyramids

An “X-ray” search will test a fascinating theory that the inner chambers found so far were decoys for thieves—and that hidden ones, perhaps filled with riches, still await discovery

By ALDEN P. ARMAGNAC

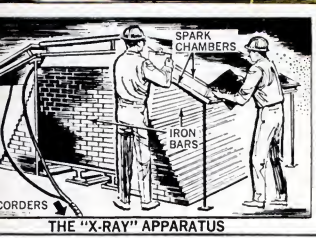
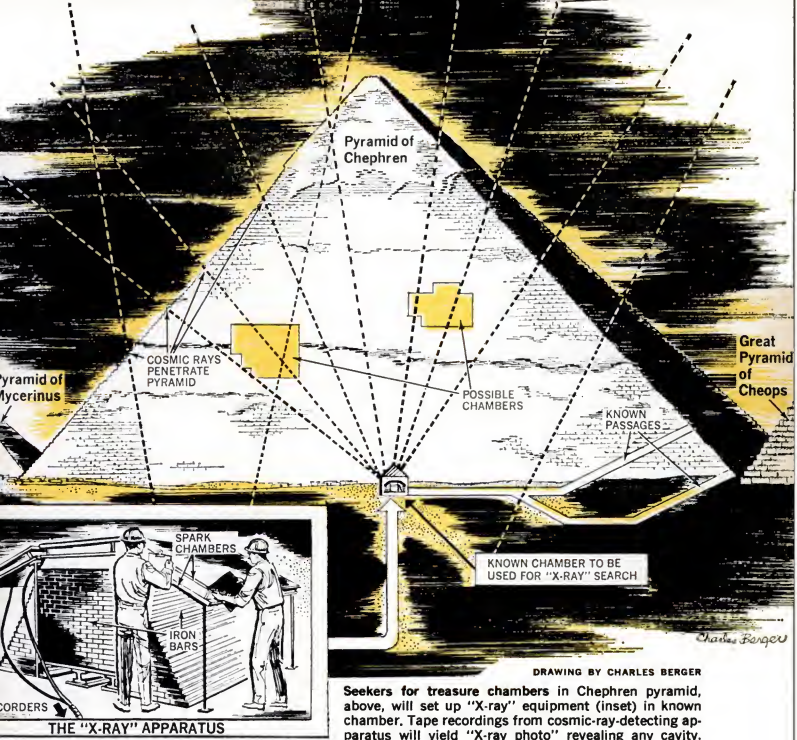
**A** treasure hunt in Egypt’s famous pyramids, using the latest in atomic-age tools to “X-ray” them, is due to get under way by the time you read this.

Sanctioned by a recent agreement between the U.S. and the United Arab Republic, the 18-month, \$250,000 Pyramid Project is jointly sponsored by the U.S. Atomic Energy Commission, the Smithsonian Institution, and the U.A.R. government. First scene of operations by a U.S.-U.A.R. team of scientists will be the huge 471-foot-high Pyramid of Chephren, at Giza—second in size only to the 481-foot Great Pyramid of Cheops nearby.

Spurring the search is a fascinating theo-

ry supported by some Egyptologists. It holds that the inner chambers found so far in many pyramids, and supposed to be the tombs of their kingly builders, were actually decoys—intended to mislead grave robbers, who would conclude that the “burial chambers” they found had already been sacked, and it would be futile to probe the pyramid further. By this theory, the real burial chambers, cunningly concealed elsewhere in the pyramids’ seemingly solid masses of limestone blocks, remain to be discovered. If so, they may hold fabulous treasures—in glittering gold and sparkling jewels or in priceless relics, perhaps even the actual mummies, of the Pharaohs of nearly 5,000 years ago.

Now, for the first time in history, it has



DRAWING BY CHARLES BERGER  
 Seekers for treasure chambers in Chephren pyramid, above, will set up "X-ray" equipment (inset) in known chamber. Tape recordings from cosmic-ray-detecting apparatus will yield "X-ray photo" revealing any cavity.

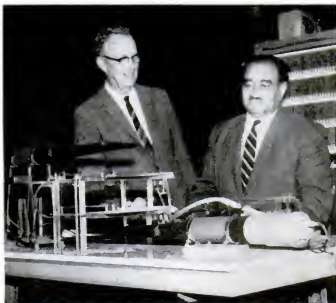
become feasible to find out. Hit-or-miss tunneling through the pyramids would be prohibitively laborious and costly—but ultramodern atomic equipment offers a way to "X-ray" a pyramid for secret chambers.

**The "X-ray" scheme.** Natural cosmic rays, some penetrating enough to pass clear through a pyramid, come from all directions of the sky. Installed in a known chamber at the bottom of a pyramid, the latest cosmic-ray detectors, called spark chambers, are ideally suited to count the arriving rays and register the direction whence each came. Any excess of rays from a particular angle would be a telltale sign of a hollow place in that direction. The current Pyramid Project had its inception when the possibility of applying this technique was pointed

ed out in 1965 by Dr. Luis W. Alvarez, famed University of California atomic scientist.

Several reasons make the Pyramid of Chephren a logical choice for the initial trial. Its one known chamber—a gable-roofed room 46 feet long, 16 feet wide, and 20 feet high—has a desirable central location and is free of rubble, readying it for installing the cosmic-ray gear. And the artless simplicity of this chamber and the connected passages make the Chephren pyramid a prime example for the "decoy" theorists. Did Chephren's architects, they ask, hide the real tombs in the hundreds of feet of stone above? It seems to them unlikely that Chephren, son of Cheops, would

*Continued*



Dr. Luis Alvarez (left), atomic scientist who proposed pyramid "X-raying" scheme, shows a cosmic-ray-detecting spark chamber to Dr. Ahmed Ali Fakhry, U.A.R. government archaeologist and authority on the famous Egyptian pyramids.

have been content with a pyramid so much simpler than Cheops' intricately multichambered one.

Set up near the chamber's west end, the treasure hunters' instruments will transmit their data, through cables laid along the 300-foot entrance passage, to tape recorders in a wooden hut outside the pyramid. Duplicate tapes of each day's recordings will go to experts in Cairo and at the University of California. At each location a computer will digest and tabulate the mass of information. Finally a readout through a cathode-ray oscillograph, whose luminous trace will be photographed by a camera, will convert the array of numbers into a picture. The resulting view will look just like an X-ray film of the pyramid—but it will have more contrast than a conventional X-ray, and so will show up any cavities more clearly.

**A month per picture.** Operating around the clock, the instruments at the pyramid will require about a month to supply complete data for a single "X-ray" view. An expert unable to restrain his curiosity could tell sooner whether something of interest was showing up, however, by calling for a print-out of the numbers accumulating in the computer's memory.

If a picture reveals a hitherto-unknown chamber, the instruments at the pyramid will be shifted 35 feet eastward, and a second view made. This will give a stereoc pair showing both the direction and distance to the newfound chamber. Tunneling to its

pinpointed location, to see what riches it may hold, will then be a comparatively simple undertaking.

**How the instruments work.** Spark chambers, the cosmic-ray detectors to be used, are a recent invention. The simplest of their varied forms employs two flat metal plates, a fraction of an inch apart. When a cosmic-ray particle passes through the plates, a high-voltage spark follows its trail between them. This permits recording the location of the particle's impact—either by photographing the spark or, better, sensing and registering its position directly on magnetic tape. Mount two such spark chambers in a tray, one a foot below the other, and the relative location of a cosmic ray's passage through each one will show the angle of the ray's trajectory. This is the principle to be applied in the Pyramid Project, using seven-foot-square spark chambers built for it at the University of California.

To an onlooker the setup will seem to consist largely of a five-foot-deep stack of iron bars, below the spark chambers. There is a technical reason for it: Lest the image of a 300-foot-distant chamber be fuzzy, the cosmic rays used for "X-raying" should have enough energy left after penetrating the pyramid to go through the iron bars, too. Beneath the stack are scintillators that, when struck by a cosmic-ray particle, trigger the spark chambers to record it; to cosmic rays of less energy, the spark chambers are oblivious.

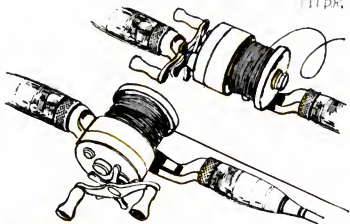
To detect a secret chamber anywhere in the pyramid, a series of "X-ray" views in five directions should suffice. The first view, looking straight up, will be given by a spark-chamber tray in a horizontal position. For oblique views a tray will be tilted toward north, south, east, and west. The drawing on the preceding page shows the first three of these positions.

**Other pyramids eyed.** Discovery of a new chamber in the Pyramid of Chephren would assure that the treasure hunt would be extended to other pyramids. Both the Great Pyramid of Cheops at Giza and the 302-foot-high Bent Pyramid of Snefru, father of Cheops, at Dahshur, have an elaborate system of known chambers—but many experts are far from satisfied that the true burial chambers have been found. These two pyramids are therefore considered likely choices for further Pyramid Project operations by the atom sleuths. [3]

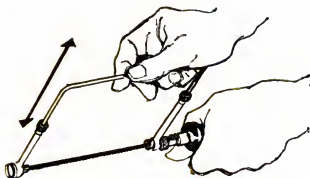
# "I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

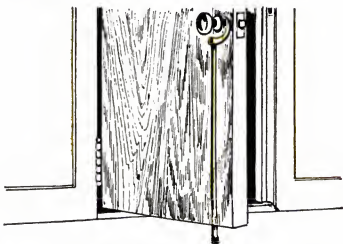
**Sleeker bicycles** with the brake and gear cables running inside a hollow frame. This would eliminate any surface cables.—*Joe Wirtala, Gainesville, Fla.*



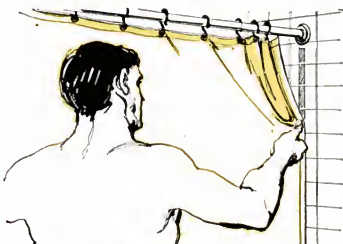
**Bait-casting reels** with hinged spools. The spool would swing out and cast like a spinning reel, then swing back and lock for a powerful retrieve.—*E. G. Kardauskas, Lincroft, N.J.*



**Telescoping frames** on coping saws. Raised to full height, they'd allow deeper cuts in thick stock. Retracted, they'd make the saw compact for storage.—*T. R. Hayes, Lake Oswego, Ore.*



**Built-in doorstops** in hollow doors. A slide lever below the doorknob would lower the stop to "lock" the opened door at any desired position.—*John Kusek, Prairie Valley, Kans.*



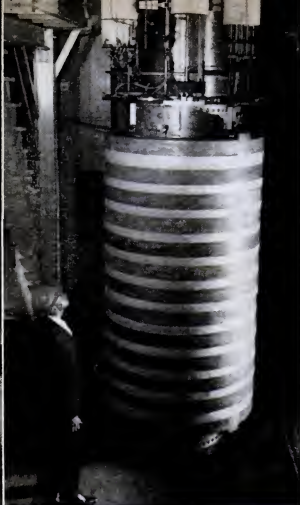
**Lock-tight shower curtains** with an interlocking fabric (like Velcro, the stuff used in place of zippers on clothing) on the edges and on meeting tile surfaces.—*R. A. Jumonville Jr., Houston.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.



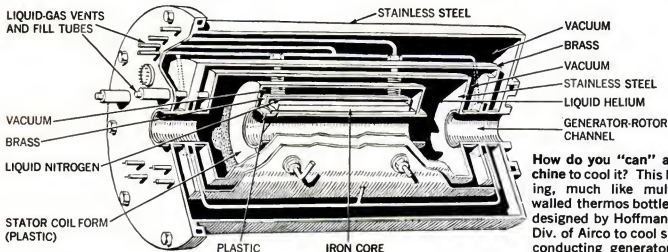
Liquid helium boils off from open Dewar flask as GE scientist removes superconducting magnet coil. At base of coil is a flux pump, which converts small AC to large DC currents.



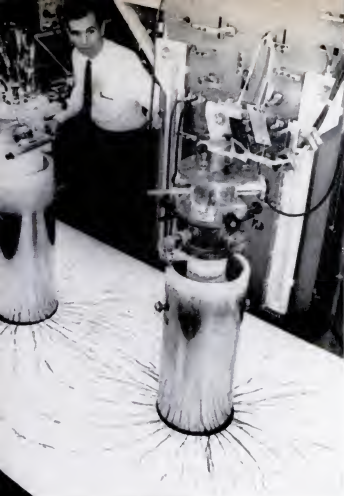
World's largest, Avco superconducting magnet stores energy of nine sticks of dynamite, has field 80,000 times earth's.

# The Frigid 'Perpetual Motion Machines of

Frictionless motors and bearings? Electromagnets that run without power? Here's how supercold is producing startling new developments



How do you "can" a machine to cool it? This housing, much like multiple-walled thermos bottle, was designed by Hoffman-Paul Div. of Airco to cool superconducting generator.



Iron nails trace magnetic lines in simplest experiment with GE superconducting magnets. The highest fields—up to 132,000 gauss—are inside coils.

# Tomorrow

By W. STEVENSON BACON

**F**ar down on the temperature scale near absolute zero (minus 459 degrees F.) lies a strange world of "electrical perpetual motion"—or superconductivity—where electric currents, once set in motion, flow forever. With new developments in materials and the methods for cooling them, truly fantastic devices are taking shape in laboratories across the country:

- Superconductive motors that operate with greater efficiency than any rotating machine ever built (the energy used to refrigerate them notwithstanding)—because of both resistance-free windings and frictionless superconductive bearings.

- Superconductive generators that put out more power with less weight and volume than anything yet known.

- Superconductive bearings and gyroscopes that "float" in vacuums or liquid helium.

- "Fast-thinking" computer logic elements known as cryotrons. The newest of these from IBM, never before revealed, is based on a phenomenon called electron tunneling, and operates at speeds of less than a billionth of a second.

- Tiny threadlike wires 1/100-inch in diameter, made of exotic materials, that carry currents of 300 amperes—without resistance, without heating. A conventional room-temperature conductor would have to be 600 times larger.

- Direct-current transformers, thought to be impossible before supercold techniques.

- Devices known as "flux pumps" that convert small voltages, currents, and magnetic fields to large ones.

- Superconductive magnets and solenoids, tiny in relation to comparable electromagnets, which form fields many times stronger than that of earth and operate forever, given a jolt of starting current. They are the first of the new "perpetual motion" machines to come of age, and one manufacturer (RCA) now makes them on an assembly-line basis.

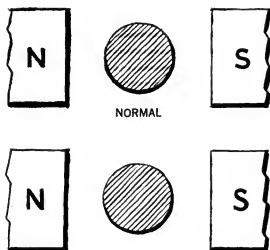
**Seeking the "impossible."** The search for electrical perpetual motion spans 50 years. It is a fascinating story, one full of accidental discoveries, years of frustration, and then the slow, gradual uncovering of new clues that have today brought us to the threshold of an exciting new technology.

Normally, metals have resistance to the flow of electricity, and much of the energy fed into a wire is wasted as heat. Why?

The atoms of copper, for example, are bound together to form molecules, and the molecules to form a highly ordered three-dimensional grillwork or lattice. There are plenty of "free" conduction electrons that can move through the lattice carrying an electrical current. Unfortunately, at any temperature above absolute zero, heat energy causes a great deal of disorder. The lattice structure is in a constant state of vibration, and it scatters the electrons, generating even more heat, more agitation, and more resistance to the flow of current.

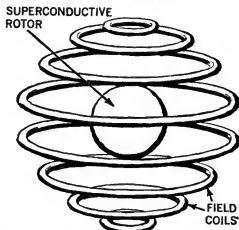
Around the turn of the century, Dutch

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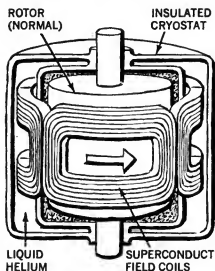


**Pure superconductors expel flux in a magnetic field. This property makes them useful for bearings, gyroscopes, flux pumps, and a variety of other devices.**

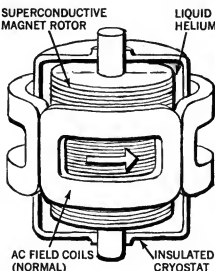
**Pure superconductors expel flux in a magnetic field. This property makes them useful for bearings, gyroscopes, flux pumps, and a variety of other devices.**



**Gyro, conceived by J. T. Harding and R. H. Tuffias, uses superconducting sphere supported by coils magnetized in opposite directions. Similar devices have been built.**



**One approach to motor design (left) is to use superconducting DC field coils, keeping rotor (armature) normal. Another (right) uses superconductive rotor, while AC is applied to normal field coils to furnish rotating field. Some completely cooled designs—incorporating superconducting bearings—have also been constructed and run in liquid helium or radiation-cooled vacuum at up to 20,000 r.p.m.**



## At -452 degrees, metal floats in a magnetic fi

physicist Kamerlingh Onnes determined to find out how much the resistance of a metal could be reduced by extremely low temperatures. He was able to do so, for he was the first to succeed in liquefying helium. At its incredibly low boiling point of -452 degrees F. (4.2 Kelvin), it offered the first practical way to cool a metal down close to absolute zero.

Working with purified mercury, Onnes measured its resistance as the temperature fell. At first, things went as predicted. Then, suddenly, inexplicably, at a temperature of 4.15 Kelvin, the resistance disappeared altogether. Once set flowing in the mercury, a current would flow forever. Dumbfounded, Onnes realized that he had stumbled onto an entirely new state of matter, one in which a kind of perpetual motion or superconductivity was possible.

It remained for German physicist Walther Meissner in 1933, 22 years later, to discover another astonishing fact. Pure superconductors, placed in a magnetic field, force out the magnetic flux. A few of the possibilities: frictionless superconducting bearings that float in a magnetic field, error-free gyroscopes—even a transit train that floats suspended above its superconducting rails by virtue of its magnetic field has been proposed.

**Solving the riddle.** What was superconductivity and how could it be used? The puzzle vexed scientists for 50 years. The bait—fabulously efficient ways of transmitting and using electricity—was tempting, but the problems were many. Onnes quickly discovered that his superconductors, notably lead wire, had severe limitations. He tried to build a magnet only to find that the lead ceased being superconducting in a magnetic field. A strong flow of current had the same effect.

Theory didn't help much. It's easy to understand why resistance gets less as temperature drops. Take away heat and you lessen lattice vibrations and electron scattering. But complete absence of *any* resistance is something else. To make things worse, superconductivity occurs at temperatures well above absolute zero—at above 18 degrees Kelvin in recently discovered compounds.

Then, in 1957, the first workable theory of superconductivity

was evolved by three brilliant scientists: J. Bardeen, L. N. Cooper, and J. R. Schrieffer.

Although electrons are of like charge and normally repel each other, in the frigid world close to absolute zero an unprecedented phenomenon called "electron pairing" occurs. Subjected to intense cold, they literally condense—like drops of water on a cold surface—down to a lower

## electricity flows endlessly and forever

energy or quantum level. At this level, tiny attractive forces occur between electrons of opposite spins and equal and opposite momentums. They interact with each other and with the lattice, exchanging with it phonons (quanta of vibrational energy), much like two tuning forks of the same frequency mounted close to each other on the same base. And the electron pairs interact with other pairs in the superconductor in wavelike fashion.

What keeps the electrons from colliding with the lattice and giving up their energy as heat? The answer lies in quantum mechanics, said the scientists. A certain binding force holds the electrons together, reducing their potential energy. If one electron of a pair should be scattered, its potential energy would take a quantum jump upward, more than making up for its loss in velocity.

In other words, it is impossible for the electrons—at their low energy level—to give up energy to the lattice by colliding with it; they only gain energy. Free from energy losses, the electrons become “frictionless” perpetual-motion carriers of any current impressed on them.

**The last barrier.** With a workable theory, the stage was set for the first of the “perpetual motion” machines. The problem remaining: materials that would take an intense magnetic field and stay superconducting.

Then, in a breakthrough comparable to the discovery of superconductivity itself, J. E. Kunzler of Bell Telephone Laboratories in 1961 found that certain superconducting alloys—combinations of niobium-tin, vanadium-silicon, vanadium-gallium, molybdenum-rhenium, and niobium-zirconium—would withstand magnetic fields as high as 100,000 gauss, 200,000 times as strong as that of the earth!

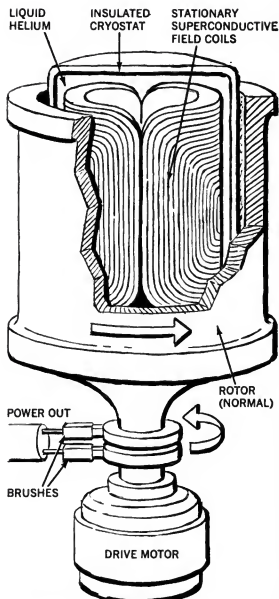
The new superconductors were labeled “hard” in contrast to the pure-element superconductors (lead, tantalum, mercury, tin, aluminum, for example), which are ductile and soft. They are also known as Type II or filamentary superconductors, which explains why they work.

In contrast to the pure superconductors, the new alloys permit magnetic flux to enter, turning certain areas of the wire normal. Super currents continue to flow, however, in tiny, threadlike filaments throughout the wire—because of the very impure composition of the wire itself.

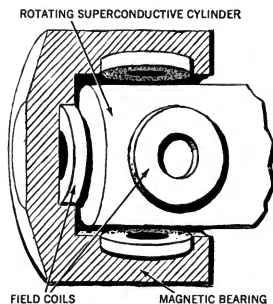
**Magnets and machines.** Superconductive magnets are often nothing more than a small coil suspended in a gleaming stainless-steel Dewar (insulated container) of liquid helium. Yet their fields compare with those of conventional electromagnets that require the entire output of a small power plant and thousands of gallons of cooling water.

What happens when you scale up a superconductive magnet? I saw the world's largest at Avco in Boston. Under a 40-foot tower, supported by nonmagnetic aluminum beams at one side of a huge laboratory, sits an enormous Dewar that holds 6,000 liters (\$24,000 worth) of liquid helium. For testing, the 10-foot, eight-ton magnet

[\[Continued on page 212\]](#)



Superconductive generator built by Avco was one of first such machines. Stationary superconductive coil in center provides field for surrounding normal rotor.



Magnetic bearing designed by T. A. Buchhold uses four field coils to support superconductive cylinder. Expulsion of flux keeps cylinder from contacting bearing.

## Pro sound tracks for your home movi



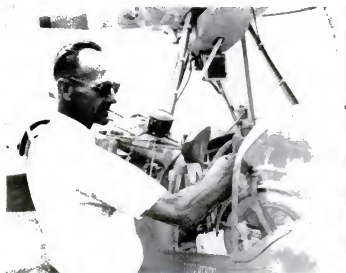
Tiny silicon carbide electroluminescent diode is smaller than a match head—1,000 units would fill a single cubic inch.

In a year or two, movie buffs may be able to make home sound movies using the same technique that Hollywood pros have used for decades: optical sound. The secret is a tiny electroluminescent diode developed by the Norton Co. This tiny chunk of silicon carbide semiconductor material emits light when an electric current flows through it (left). The brightness of the glowing diode is proportional to the current level.

In a typical optical-sound movie system (far right), sound waves striking the microphone generate a tiny, rapidly varying audio voltage. The amplifier stage transforms it into an identically varying electric current that drives the silicon carbide diode. The diode, positioned near the edge of the moving film, flickers in step with the sound waves striking the mike.

These flickers produce the characteristic optical-sound track on the film (near right).

The developed film must be replayed on a projector equipped for optical sound. The sound track runs between a lamp and an electronic photocell; the varying voltage output of the photocell duplicates the original audio signals from the mike.



Volmer Jensen removes fold-up bike from plane . . .

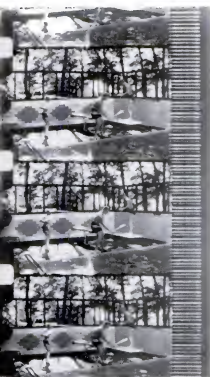


raises handlebars and pin-locks them in place . . .

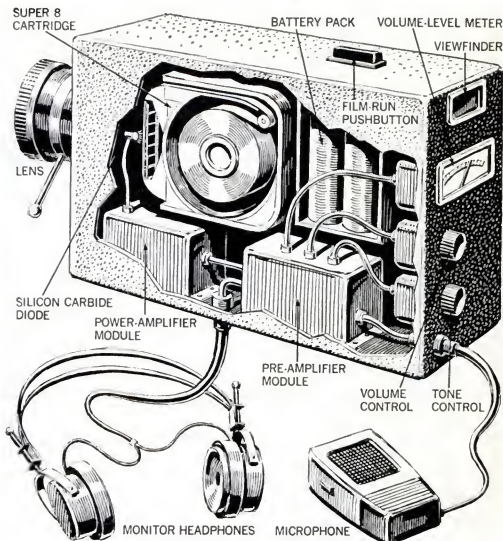
### Folding scooter on plane gives pilot "wheels" for land travel

Airplane designer Volmer Jensen of Burbank, Calif., never has to look for a taxi when he lands his lightplane. Jensen carries a fold-up scooter in his cockpit that sets up in seconds. The scooter

# n the way



ical-sound system works fine on  
er 8 film, which provides  
ce for sound track on edge op-  
ite sprocket holes. The flicker-  
diode, pressing against moving  
, alternately underexposes and  
rexposes adjacent strips at  
's edge, producing multiband  
cal sound track (above). DuKane  
D., St. Charles, Ill., makes a  
er 8 projector for optical sound.

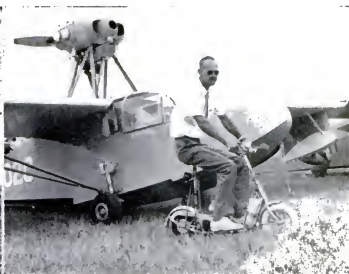


Artist's interpretation (above) of an optical-sound home-movie camera shows only the sound-system components. The film transport could be electric-motor drive. System uses Super 8 cartridge.



raises seat mount and locks it in place...

is 30 inches high and 48 inches long. It has 12-inch wheels and is powered by a four-hp. West Bend engine—enough power to hit speeds up to 35 m.p.h. The bike weighs only 38 pounds and



and, bike set up, he's ready to travel on land.

easily fits into the second seat of Jensen's two-seater plane. The scooter has a one-quart fuel tank, which gets him to his business appointments and back to the plane with gas to spare.



Today's over-ocean jets, like the scale model at left, tote 150 passengers, eight steward

## Come Fly to Europe with

No matter how much you have flown, nothing has prepared you for this kind of air travel

By DEVON FRANCIS

**O**n a day less than three years from now, the first of a brand-new fleet of jumbo jet airliners will lift off a runway at New York bound for Paris.

Come along with me. I'm going to take you on a preview trip in this fabulous airplane.

Everything about it has to be said in superlatives. First of all, its sheer size staggers the imagination—it will carry up



crewmembers. Jumbos (right) will carry 360 persons, 18 stewardesses, same crew. Count 'em.

## Me in the New Jumbo Jet

to 450 passengers in domestic service, 360 on longer, transoceanic hops. Today's biggest planes seat 250 domestically, less on flights between continents.

Fully loaded, our jumbo jet will weigh 320 tons. That's 173 tons more than any commercial transport in service today. Four engines of 42,000 pounds' thrust each, twice that of today's gas turbines, will give it a cruise speed of 600 miles an hour.

That's 50 miles an hour faster than today's airliners, and the figure won't be exceeded until the first of the supersonic transports enters service in 1971.

The airlines believe the jumbo jet will have a far more profound influence on the growth of air travel than the SST [PS, Dec. '66]. That's because you probably will be able to buy a ticket on it at two-thirds of

*Continued*



Author is handed magazine by stewardess in Boeing jumbo jet mock-up. Lockheed has proposed even bigger monster transport for up to 900 passengers.



Interior arrangement of the Boeing jumbo will vary with individual airline. In this mock-up, staircase leads from first-class section to upper-deck lounge.



Passenger- and cargo-loading patterns will vary, too. This is one possibility. U.S. has competition—a coming Russian turboprop will seat 724 passengers.

## You'll ride in a room—not

today's fare—airline seat-mile costs plummet as planes get bigger.

Let's check in for our flight, Pan American World Airways schedule 100, due to take off at eight p.m. and to land in Paris six hours later.

**Luggage no problem.** We deposit our luggage in great containers that will be rolled into the plane's belly. They are color-coded. At Paris our bags will be almost instantly available—the containers simply will be rolled off the plane.

At the airport there is not one waiting room for us passengers, but four, and they, too, are color-coded. Our flight is called.

"Pan American," says the public address system, "announces the departure of Flight 100 for Paris. Passengers will please board by the color codes on their tickets."

Our plane, the Boeing 747 model, has 10 entrance doors, five on each side of the fuselage. For years we have been accustomed to entering a cabin that looked like a long tube. This passenger compartment looks like a room. It is. It's actually wider—at 19½ feet—than the length of many home living rooms. Nine passengers sit abreast in economy class with more hip room than any airplane has provided before. (First class will offer luxury you never dreamed of.) From the front of the passenger compartment to its back end, it's 188 feet. There is not one aisle running the length of the room, but two.

Other things tax our credulity. The familiar pantry with its food containers has



Sixteen-wheel main landing gear of U.S. jumbo jet will weigh 11 tons. Wingspan will be 195 feet, length 228 feet, height 62 feet, range 6,000 miles.

## be—almost 20 feet wide and as long as a city block

been replaced by four complete kitchens that were loaded aboard, each as a unit, 30 minutes before. There are 11 lavatories.

At the front of our room is a spiral staircase leading to an upper-deck lounge. Just forward of it is the flight deck.

**Computers at work.** Fascinating things have been going on on the flight deck. Our entire journey has been run through an off-board computer in advance. The computer has been fed such data as anticipated winds, temperatures en route, weather, and our airplane's performance characteristics. It cranks out the latitude and longitude of the check points we shall cross, time to destination, optional alternate landing sites, climb and cruising speeds, time from check point to check point, and the amount of fuel we shall burn.

On board, the flight deck has a series of its own computers, combining data on actual air speed, power settings, fuel flow, engine temperatures, outside air temperatures, and latitude and longitude in easy cumulative readouts within the customary dials on the instrument panels. This simplifies the flying—it's like reading a speedometer and odometer in your car. All the

way the airplane's anticipated performance and its actual performance will be compared on an instrument-panel display.

It's time to leave. We taxi out. At the downwind lip of the runway the crew checks the engines.

These engines are like nothing else airliners have used before except in principle. Heretofore, for each pound of thrust produced by the combustion of fuel, 1½ pounds came from cold air routed around the engine, outside the combustion and turbine cycle, but within its sheath. But the ratio of thrust between cold air and hot gases in these engines is 5:1. That cold-air thrust comes from the fan sections of our fan jets.

**Takeoff.** Everything is in order. The captain releases the brakes. At 135 knots, "rotation speed," the captain pulls back on the control yoke—the "stick." We come unglued from the runway. The floor of our room slants upward. Exactly 30 seconds have elapsed since the brakes were released. That's faster than the smaller 1967 jets, and we've used less runway.

At 1,000-foot altitude, now out of the

*[Continued on page 208]*



**Bigger and more efficient engines are the real reason for the revolution in passenger-jet sizes.** At left is Pan Am's present turbofan engine, with air-inlet

diameter of four feet, nine inches. At right is prototype of Pratt & Whitney jumbo jet engine, with diameter of eight feet, eight inches.

What will the new European color-television systems be like

# AROUND THE WORLD

By **RONALD M. BENREY**  
PS Electronics Editor

**A**t last count, there were several hundred million TV sets throughout the world, in a hundred different countries—most of them color-blind. But things are changing: The incredible color-TV boom now sweeping the United States, Canada, and Japan is about to explode into Europe.

By the end of this year, Great Britain, West Germany, France, the Soviet Union, and Monaco will air their first color telecasts. By the end of this decade, the rest of Europe and a handful of Middle Eastern and Asian nations will jump on the color-TV bandwagon.

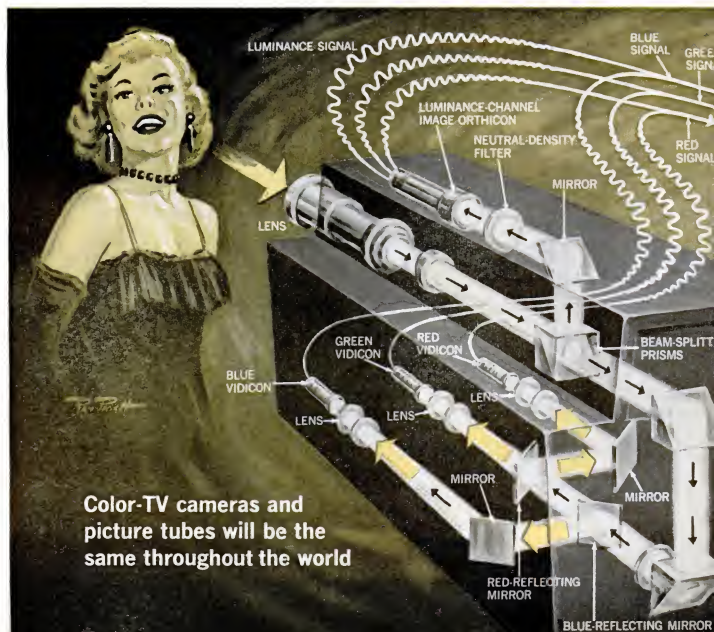
Actually, they will jump on one of three bandwagons. For the fact is that there are three different color-TV systems in direct, international competition:

- **N.T.S.C.** (for National Television Systems Committee), developed in the U.S. during the early 1950s, and now also on the air in Canada and Japan.

- **SECAM** (from the French phrase *Sequential à Memoire*, or Sequential-with-Memory). This French-developed system has also been adopted by Monaco and the USSR.

- **PAL** (for Phase Alternation Line) system. This is the West German entry, and will be installed in Great Britain as well.

**The trouble with N.T.S.C.** The Europeans set out to develop their own color systems



me with us as we tune in

# WITH COLOR TV

from scratch rather than adopt the successful American N.T.S.C. system for an important technical reason: An N.T.S.C. color signal is easily distorted when it is carried long distances over coaxial cable and very high radio-frequency links. This distortion produces the green flesh tones and purple bananas that were common in the early days of American color TV.

Our three major TV networks have learned how to pipe N.T.S.C. color signals from coast to coast with negligible distortion. However, the necessary equipment is complex, and expensive to buy and maintain.

European engineers chose a different route: Rather than replace their existing black-and-white network facilities with

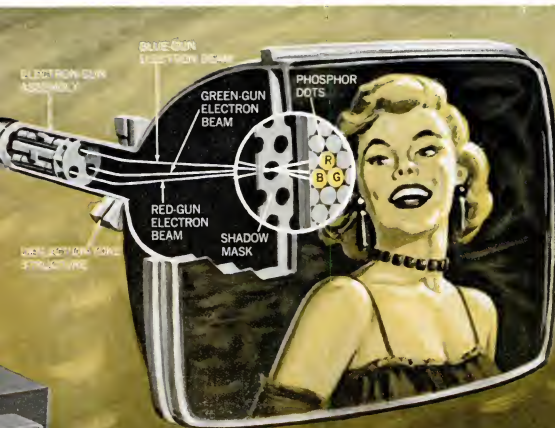
N.T.S.C. color-capable equipment, they elected to create color-TV signals that are inherently immune to distortion.

They've succeeded—but at a price. European color-TV sets will be slightly more complicated, and consequently more expensive, than N.T.S.C. color receivers.

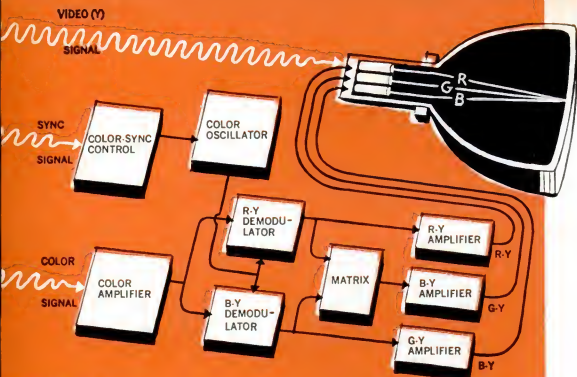
The hue (or tint) control required on all N.T.S.C. sets also disturbed the Europeans. This is an especially critical knob. Even a slight misadjustment distorts the picture colors noticeably.

Both SECAM and PAL receivers dispense with this control. Since neither PAL nor SECAM signals are prone to distortion, set designers need not add a control to compensate for slight signal distortion that may occur during transmission.

*Continued*

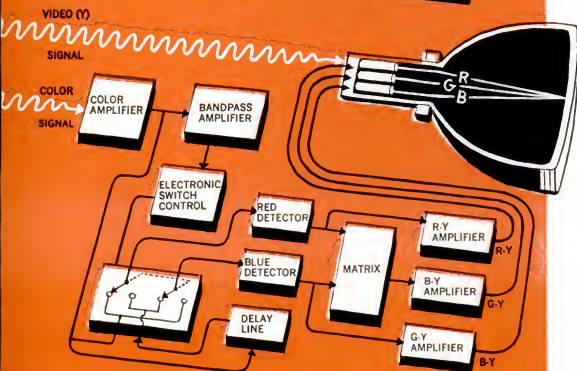


All of the proposed international color-TV systems utilize the same color camera (left) and cathode-ray tube (above) as the American—or N.T.S.C.—system. The first crop of foreign color sets will probably have 19-inch rectangular picture tubes. The real differences among the competitors center on how the three color signals—red, green, and blue—originated by the three color vidicon tubes in the camera, are transmitted to the three electron guns inside the picture tube's neck.



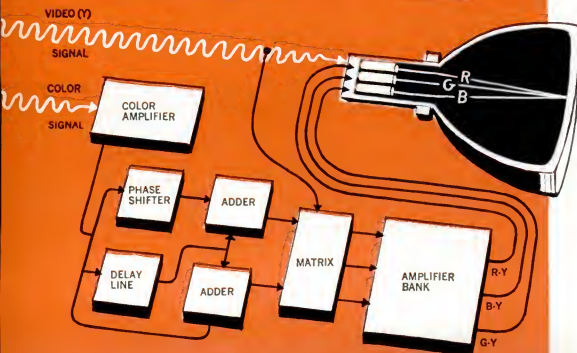
## Here's how the th N.T.S.C.

This system has been operating successfully in the U.S. since 1954. However, N.T.S.C. composite color signals are easily distorted because the critical phase relationship of the quadrature-modulated sub-carrier is all too easily disturbed. Unless studio and broadcast equipment is specially designed to minimize phase changes, the received picture colors will be substantially incorrect. In practice, this is a difficult and expensive task.



## SECAM

The greatest virtue of this system is its extreme operating simplicity. Neither European system needs a tint control on its sets, but SECAM goes one step further: French and Soviet color TVs won't have the color-intensity controls (roughly equivalent to a color "volume control") found on all PAL and N.T.S.C. color TVs. Thus, a SECAM set will have the same number of operating controls to manipulate as a conventional black-and-white receiver.



## PAL

This system is really just a more complex cousin of our N.T.S.C. system. The idea behind it is simple. Since the two quadrature-modulated sub-carrier segments, which are alternately broadcast, are completely reversed in phase, any phase errors caused by faulty equipment will affect the two signals in a reversed fashion. Thus, when the two segments are added together, the reversed-phase errors cancel themselves out, leaving a perfect R-Y and B-Y signal.

# Major international color systems compare technically

**How do they stack up?** An obvious question is: "Are the European color systems better than ours?"

Side-by-side viewing comparisons have proved that the only significant European-system advantage is operating simplicity: A properly adjusted N.T.S.C. set produces as good a color picture.

This isn't too surprising when you consider that the fundamental differences among the three systems center on how the color information, produced by the color-TV camera, is placed on the TV signal, and on how the received color-TV signal is decoded once inside the set.

In all three systems the function of the color signal and the receiver's circuitry is to connect—electronically—the three electron beams within the receiver's picture tube with a set of light-sensitive pickup tubes inside the studio's color-TV camera.

The three beams sweep in unison across hundreds of thousands of tiny red, blue, and green phosphor dots, grouped in clusters of three, called triads, on the tube's faceplate. A perforated-metal shadow mask directly behind the phosphor dots forces each of the three beams to strike only dots of one color.

Because each dot glows—red, green, or blue—when its corresponding electron beam strikes it, the three beams working together literally paint a color picture on the face of the tube: Your eye automatically blends the closely spaced pinpoints of red, blue, and green light into a complete color picture.

The color camera shown in the diagram, for all its apparent complexity, is a very straightforward device. Inside it, four light-sensitive TV pickup tubes scan the subject to be televised and generate four tiny signal voltages simultaneously:

- A high-resolution image orthicon produces a signal that represents the brightness (or luminance) of every element in the subject. This signal is labeled Y.

- Three identical lower-resolution vidicons generate three signals—R, G, and B—that represent the proportions of red, green, and blue light, respectively, that must be blended together to duplicate the color of each element of the subject.

The camera's internal optical system beams part of the light gathered by the lens

to the image orthicon and splits the remainder up into red, green, and blue components with a set of dichroic mirrors that reflect light of a specific color and pass light of other colors.

Eventually, these four signals—R, G, B, and Y—will control the intensity of the electron beams inside every color set tuned to the telecast.

Why are four signals needed to control three electron guns? A good question—and therein lies a tale:

**Color vs. brightness.** Due to a quirk of human vision, our eyes cannot distinguish the relative colors of two tiny objects placed side by side, although they can readily distinguish the objects' relative brightness. This fortunate human shortcoming allowed the developers of all color-TV systems to:

1. Produce a compatible color system—a black-and-white TV will transform the received color signal into a good-quality monochrome picture.

2. Squeeze a complex color-TV signal into the same size channel—a six-megahertz-wide band of frequencies—originally specified for black-and-white transmissions.

At a quick glance, the signals broadcast by all three color-TV systems look very much alike: Paradoxically, they closely resemble conventional black-and-white TV signals. This is because the high-resolution brightness, or Y, signal (which we will call the "video" signal)—a complex blend of high- and low-frequency components—fills most of the channel bandwidth.

A closer look reveals that the low-resolution R, G, and B signals, in a disguised form, are crammed into the remaining empty narrow nooks and crannies in the channel.

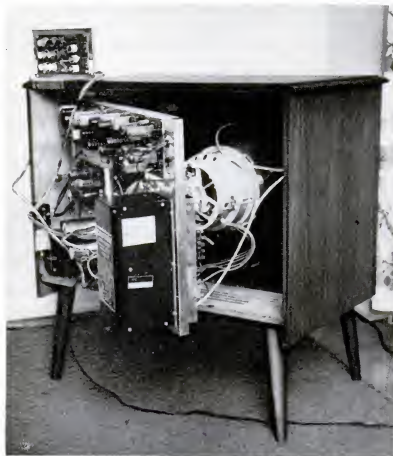
When a black-and-white set receives the signal, it simply discards the color information, and uses the video (or Y) signal to produce a black-and-white picture.

When a color set receives the signal, though, it uses all the information it contains: The video signal supplies the picture's fine detail, and the disguised R, G, and B signals fill in the color. To visualize this process, think of a child's coloring book: The high-resolution video signal is analogous to the printed fine-detail lines on the page; the low-resolution color-signal

*(Continued on page 210)*



Touching up the color-killer control (above) is the last alignment step. Most of the circuitry is mounted on a hinged chassis that swings out (shown in the photo below) for easy servicing. The small panel temporarily mounted atop the cabinet holds the set's convergence controls.



## First Report: The 19-Inch Color TV You Build from a Kit

**H**ere's a compact color set just right for a budget-bound TV fan who is also short on floor space—if he's willing to swing a screwdriver and soldering iron for about 25 hours. It's Heathkit's new 19-incher, the GR-180. The chassis kit costs \$380; the trim, preassembled cabinet is \$50.

The 27-tube chassis is virtually a carbon copy of the insides of Heath's 25-inch color TV [P.S. May '66], which makes it one of the most elaborate 19-inch color sets you can buy. My tests proved it to be a top performer: The picture is as good as the best I have seen on any color set.

My only complaint is that the small front-mounted oval speaker—an unfortunate by-product of the small cabinet dimensions—limits the set's sound quality. One solution is to pipe the unamplified audio signal into a nearby hi-fi rig.

The kit goes together smoothly in spite of its apparent complexity: The critical tuner, IF, and high-voltage power-supply stages are preassembled, and most of the other components are mounted on three easy-to-wire printed-circuit boards.

The instruction manual is up to Heath's usual high standards, and contains a wealth of information about servicing and troubleshooting the finished set yourself. This could save you \$75 a year in service costs.—*R. Benrey.*

## Evinrude and Johnson have 115-hp. outboard

OMC's Evinrude and Johnson divisions have unveiled a new high-performance outboard that can push powerboats to 65 m.p.h. with single engine and 80 m.p.h. in twin-engine operation. The full potential of the new engine can't be obtained unless used on family runabouts designed for 40-m.p.h. top speed. The new 89.5-cu.-in. engine is practically identical to the Johnson and Evinrude 100-hp. engines,

but it has a more streamlined lower unit that cuts drag. OMC achieved this by using a dual-shaft gearing design in which two small sets of gears transfer power from the engine to the propeller, rather than using one larger gear to do the job. The new engine has a .61:1 gear ratio compared with the 100-hp. engine's .57:1. The big engine's high reduction ratio turns



The Johnson GT-115



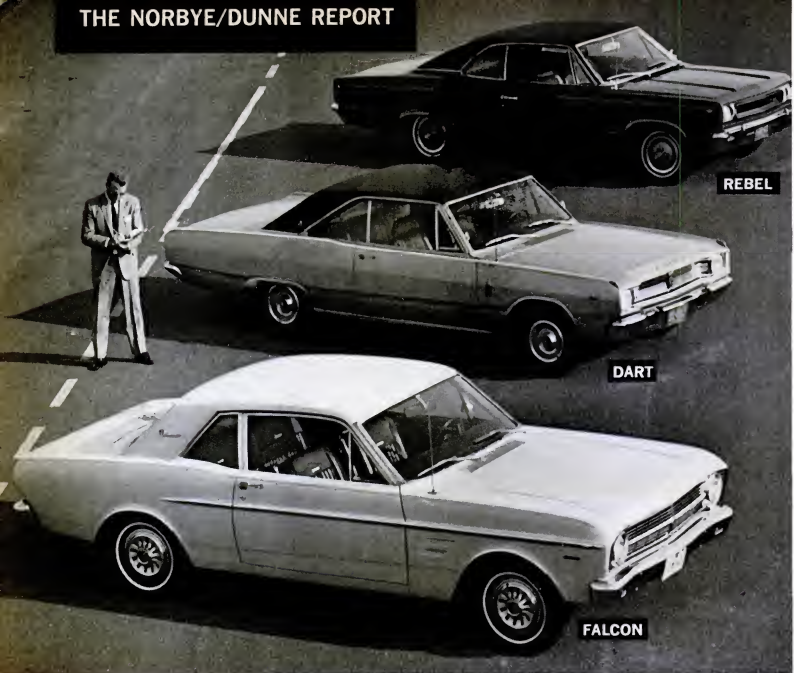
The Evinrude X-115

the propeller at 6/10 of engine speed. The engine is designed for both water-level or underwater exhaust. It is also economical in fuel consumption, burning .64 pounds of gas per hp. per hour. The engine uses a 40:1 gas-oil mixture for high-speed use, a 50:1 mixture for normal. The engine will be available in May from Evinrude and Johnson dealers.



## Polaroid's new 210 is its cheapest color camera

The 210 is the least-expensive Polaroid color camera ever marketed. At \$49.95, it is the lowest-priced of the five new 200-series cameras Polaroid has just put on sale. The 200-series cameras replace models 100, 101, 103, and 104. All the cameras use the same eight-exposure film packs—108 for 60-second color prints, and 107 for 15-second black-and-white prints. The 210 has an automatic electronic shutter, but requires a flash for indoor exposures. The other cameras in the 200 series are the 220—\$74.95; 230—\$99.95; 240—\$129.95; and 250—\$159.95.



## The youthful not-so-compacts: Dodge Dart GT•Ford Falcon

A far cry from the compact cars of yesteryear, these three jobs will tempt you if you're looking for a sporty car with a real back seat

By JAN P. NORBYE / PS Automotive Editor

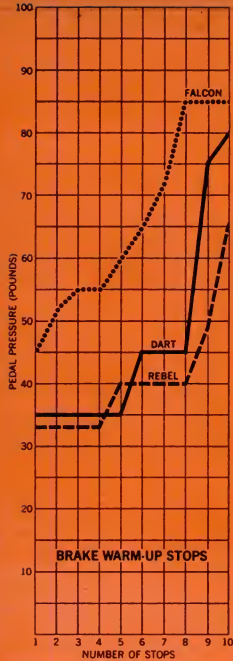
PHOTOS BY BILL MORRIS

**W**hen is a compact not a compact? When it's a Ford Falcon. The Falcon shares many underbody parts, engines, transmissions, and suspension units with Ford's Fairlane, but is shorter and lighter. The best description: a "not-so-compact."

Another example is Dodge's Dart. It's

built on the same size wheelbase as the Falcon. It shares many power-train and running-gear parts with the shorter-wheelbase Plymouth Valiant, but is a roomier automobile.

Rambler's Rebel is almost an intermediate. With 114 inches of wheelbase, it's



Dart: We expected disk brakes to stop the car quicker.



Falcon: With small drum brakes, it gave fair stopping.



Rebel: Disappointing disk brakes and strong nose dive.

DART	202 FT.	120 LB.	0.67 g Max.
REBEL	217 FT.	165 LB.	0.72 g Max.
FALCON	205 FT.	95 LB.	0.66 g Max.

STOPPING DISTANCE (FEET), PEDAL PRESSURE, AND MAXIMUM RETARDATION

## utura•Rambler Rebel SST

only one inch down from Chevelle and tempest. But it's not nearly as roomy as the 117-inch-wheelbase intermediates from Chrysler Corp., and it's a lot shorter on space than AMC's own Ambassador, built on a 118-inch wheelbase.

Wheelbase is perhaps not a good basis for identifying car sizes. But what is? Length? Weight? Seating capacity? Let's forget about classification for a while and just look at three cars that have a lot in common:

- Sporty looks.

- Usable rear seat.
- Impressive power options.
- Competitive basic price tags.

We asked for sports coupes with popular V-8s of under 300-cu.-in. displacement, automatic transmissions, power steering, and power brakes. American Motors didn't have an SST with the 290 V-8 available, but offered us a hot 343. Dodge's four-barrel 273 Dart GT came with four-on-the-floor. The Falcon's 289 V-8 was the low-compression, two-barrel job instead of the 225-hp., four-barrel version that would have



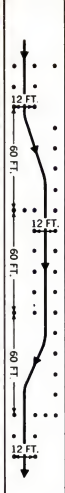
Dart wiggle-wiggled well at 65 m.p.h.



Falcon had wiggle-wobble limit of 60.



Rebel squeezed through at 60 m.p.h.



Dart took slalom test at 25 m.p.h.



Falcon set new slalom record: 30 m.p.h.



Rebel could make only 22 m.p.h.

Wiggle-wobble test simulates a high-speed lane change, with return to original lane—all inside 180 feet. Dart set new record with several clean runs at 65 m.p.h. with the car in full balance.

Slalom test simulates narrow mountain road or tight traffic with frequent steering reversals and high steering angles. Power-steering pump catch limits most cars' performance in this low-speed test.

been a closer match for the Dart on acceleration. The surprise in speed tests was that the Dart came out ahead of the Rebel in the standing-start quarter-mile.

The Dart GT also outstripped the other cars on 25-70-m.p.h. acceleration, with times of 8.4 seconds using second gear, and 10.8 seconds in third. The Falcon got full kick-down to Low at 25 but lacked the power to do better than 18.4 seconds, while the Rebel, which did not kick down into Low, took 11.6 seconds from 25 to 70 in intermediate. The selector was in D-1, which is supposed to give full downshift.

I did not expect too much from the

Falcon's standard drum brakes, and they gave fair stopping. But I was disappointed in the disk brakes on the Rebel and Dart. I expected stops in under 160 feet from 60 m.p.h. after warmup. Both took over 200 feet.

The Dart with the GT suspension and wide-oval tires set new records for handling. One test—the high-speed constant-radius turn—shows a car's behavior in a long curve at high speed. It's a little like exiting from an expressway without slowing down. Our test turn has a 255-foot radius. Entry speed is 55 m.p.h., with full-throttle acceleration until the maximum



## “Instant” Sport

By JIM DUNNE / PS Detroit Editor

An example worth following, the Rebel has reclining backrests on both front seats as standard. Small adjustments let the driver vary his position, reducing fatigue on long trips. Co-driver can stretch out comfortably and get a good rest.



Dart did 25-70 in 8.4 seconds in second gear.



Falcon went from 25 to 70 in 18.4 seconds.

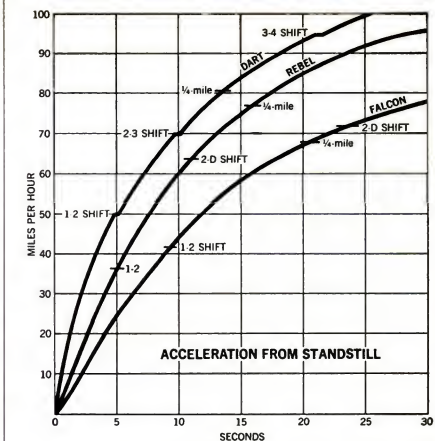


Rebel took 11.6 seconds on 25-70 acceleration.

with wheel gives true speed readings. At an indicated 60 on the car's speedometer, Falcon and Rebel were really doing 60, Dart only 58 m.p.h. See chart (right) for acceleration curves.

stained side thrust has been established. The Dart took a side thrust of 0.93 g, remaining in complete balance with neutral steering characteristics. A side thrust of one g would mean that a load equal to the car's weight is trying to push it sideways off the road. The Rebel and Falcon could not better 0.82 g. The Rebel understeered throughout; the Falcon came out of the turn in a balanced state.

In the wiggle-woggle, the Dart GT easily succeeded the Toronado's performance. The only reason it was unable to go through the mid at 70 m.p.h. was incipient pump catch. At 70, it ran over a couple of rubber cones



DART	15.9
FALCON	19.6
REBEL	15.1

AVERAGE FUEL MILEAGE (M.P.G.)

at the second barrier because I could not reverse the steering quickly enough.

The Rebel had initial strong understeer, with final oversteer, putting it way off balance when exiting from the grid. I finally made two clean runs at 60 m.p.h. The Falcon was always in control and felt safe, but failed in four attempts to squeeze through at 65. Its stable limit is 60.

In the slalom test, the Falcon beat the Dart because of the Dodge's pump catch. The Rebel's steering was too slow for my arms to work the wheel fast enough. Results: Rebel SST, 22 m.p.h.; Dart GT, 25 m.p.h.; Falcon—a new record—30 m.p.h.

## rs Are Practical—and Fun

Four years ago, before there was a Mustang, standard compact cars outfitted with bucket seats and special trim were built to satisfy a demand for low-cost, high-performance small cars with a flair. Today, these "instant" sporty cars are still around, and offer particular value to buyers.

The Rebel SST is the quietest-riding of the three cars. But it has one drawback: wind turbulence—wind noise outside the car that you hear on the inside. It starts at 25 m.p.h., continues on up to 70 m.p.h. It is most severe at 50-65 m.p.h., and is ac-

*Continued*



Rebel has self-tightening seat belts—an extra aid to comfort that the other cars do not have. It makes buckling up a little quicker and easier.



Dart's trunk is adequate in both room and layout. With a 25-inch lift-over height and a 5½-inch lip, it's the most loadable car in this group.

tually worse than most convertibles I have driven. The Dart and the Falcon had some air noise starting at 50 m.p.h., becoming loud at 70 m.p.h.

Except for a minor wind whistle in the SST at 60-70 m.p.h., none of the cars exhibited obvious air leaks in the windows.

Safety design is evident in all three cars. The Dart's door handles are the most sensible and set this car apart from the other two. The Falcon's padded interior—windshield posts, steering-wheel hub, armrests—is at least one year ahead of the other cars' interior design.

The Falcon also has a seat-belt light that reminds the driver to buckle up. Seat belts for the driver of the Dart and Rebel get caught down between the seat and the console, and it takes at least a minute to pull the console-side belt out so you can lock it into place. That big safety cushion on top of the Falcon's steering-wheel hub begins to "intrude" on driver room after you drive with it awhile. Or so it seems.

Bucket seats cut down on front passenger

room. However, the Falcon gearshift lever, located on the steering column, is in a position that permits easy passenger movement from one front seat to the other. In the Dart and the Rebel, the console and the floor-mounted shift lever almost preclude such movement.

Front-seat head room on all three cars is excellent. Back-seat room in the Rebel is also excellent with a fair amount of leg and knee room. But in the back of the Dart and the Falcon, room is, at best, "cozy."

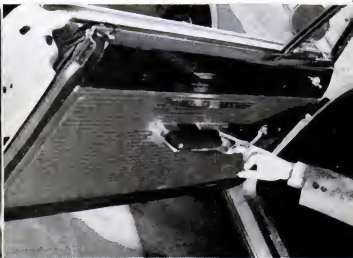
Front-seat entry room is excellent, but it takes some body twisting to get into the back seat. Back-seat entry is aided, though, by the fold-down bucket seats.

As for frets, the Rebel had a number of minor trim misfits. The console storage-compartment door didn't latch. I had trouble trying to start the Dart in the "P" position. The Falcon's trunk is even smaller on the inside than it looks from the outside. (Don't pack that extra bag!)

Overall, I think the Rebel SST is an ex-



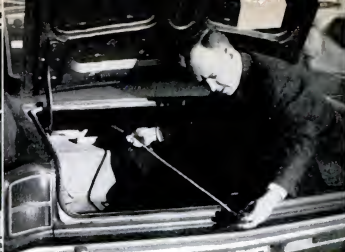
Dart sticks to "umbrella handle" on parking brake when even the Falcon has a pedal-operated one. Other controls in the Dart proved satisfactory.



Wide door in Dart GT gives reasonable access to both front and rear seats. Once again, we feel that Chrysler Corp.'s door handles are the best.



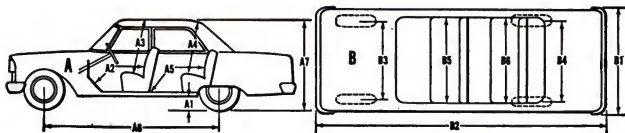
Falcon's trunk is even smaller inside than it looks from the outside. Spare-wheel mounting is okay, but fuel filler neck restricts luggage space.



Rebel's trunk is the largest of the three, but its 29-inch lift-over height and 11-inch distance from trunk floor to lip restrict ease of loading.

Excellent car. With the V-8, it's quick, easy to maneuver, and has reasonable dimensions inside and out. The Dart GT is a typical bucket-seat adaptation of a high-production car. It's an easy-driving package

with great performance and quick steering. Falcon impresses most with its tight, well-soundproofed body. In other areas, it's just about "enough." But it's fun to drive this kind of car. **P 5**



#### DIMENSIONS (inches)

	DODGE Dart GT	FORD Falcon Futura	RAMBLER Rebel SST
A1 Ground clearance	5.5	5.9	6.2
A2 Front leg room (max.)	40.8	42.1	41.6
A3 Front head room	37.3	38.8	38.7
A4 Rear head room	36.8	37.3	36.5
A5 Rear leg room (min.)	33.0	33.9	36.5
A6 Wheelbase	111.0	111.0	114.0
A7 Overall height	52.5	54.6	53.5
B1 Overall width	69.7	73.2	78.4
B2 Overall length	195.4	184.3	197.0
B3 Front track	57.1	58.2	58.58
B4 Rear track	55.6	57.9	58.5
B5 Front hip room	57.1	59.5	60.3
B6 Rear hip room	57.1	58.3	59.5

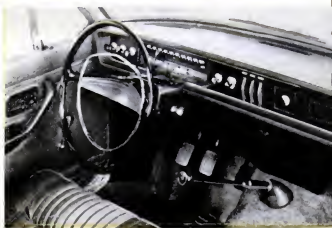
#### SPECIFICATIONS

Engine type	OHV V-8	OHV V-8	OHV V-8
Bore & stroke	3.63 x 3.31 in.	4.00 x 2.87 in.	4.08 x 3.28 in.
Displacement	273 cu. in.	289 cu. in.	343 cu. in.
Compression ratio	10.5:1	9.3:1	10.2:1
Carburetion	Single 4-bbl.	Single 2-bbl.	Single 4-bbl.
Power @ r.p.m.	235 @ 5,200	200 @ 4,400	280 @ 4,800
Torque @ r.p.m.	280 @ 4,000	282 @ 2,400	365 @ 3,000
Transmission	Manual 4-speed	Cruise-O-Matic	Flash-O-Matic
		3-speed	3-speed
Axle ratio	3.23:1	2.80:1	3.15:1
Tires	Firestone	Firestone	Goodyear
Tire size	D70-14	7.35 x 14	7.75 x 14
Steering ratio (overall)	18.8:1	21.6:1	20.6:1
Turns, lock to lock	3.5	3.5	4.4
Turning diameter	38.7 ft.	39.8 ft.	37.6 ft.
Brakes	Disk/drum	All drum	Disk/drum
Brake-swept area	314.7 sq. in.	251.4 sq. in.	371 sq. in.
Curb weight	3,237 lb.	3,042 lb.	3,561 lb.
Basic price	\$2,627	\$2,543	\$2,709
Price as tested	\$3,160	\$2,896	\$3,515



Grin on Norbye's face there for a reason: He just discovered—after a few hot laps on ride-and-handling course—that this compact sedan handles like a good sports car. Tests were made at Volvo's proving grounds in Sweden. Below, cockpit interior combines simplicity and function.

**Built-in roll-over bar, energy-absorbing front and rear body sections, pop-out windshield, fail-safe all-disk brake system, divided steering shaft, and many other safety features—all in one car**



## Great New No-Nonsense

By JAN P. NORBYE / *PS Automotive Editor*

**W**ith this new model, Volvo takes a leading position in that small group of auto makers who have initiated safety features and standardized them on production cars. Others are Mercedes-Benz, Rover, Citroën, and Saab. But I was even more impressed with the way the Volvo drives than with its long list of safety features (which I had no intention of putting to a test).

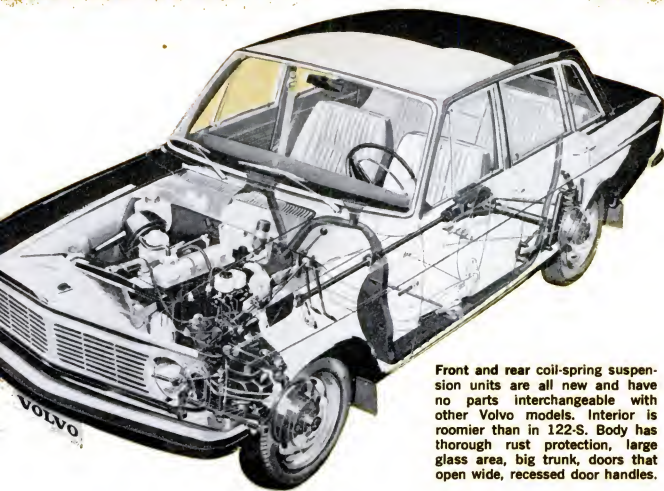
This is the first new Volvo in six years, and I went to Sweden to test it. This turned out to be some test! I drove at seemingly impossible speeds on narrow, twisting dirt roads, stormed along beside quiet lakes and through deep forests, and cruised at an indicated 100 m.p.h. on the highway (no speed limit!). This practical, no-nonsense sedan, which seats four in comfort, took it all in stride, and gave about 25-m.p.g. gas economy, too.

Its 115-hp. engine makes the 144-S a very agile car, though less than breath-

taking on a dragstrip. On the road, it's one of the fastest cars I can think of. Watch out, Alfa Romeo, BMW, and Rover! Steering is light, quick, and precise. Side-bite on fast turns is better than on many sports cars.

And does it stop! Man, did you say stop? It has big disks on all four wheels. What's more, one hydraulic circuit operates half the wheel cylinders in both left and right front calipers plus the two wheel cylinders in the right rear. The other circuit is a mirror-image of the first. Should one circuit fail, braking action remains normal and the car stays balanced. I tried this out on an experimental 144 and was fully convinced. Stopping distance went up a bit, pedal pressure rose, and the pedal went down farther. That's all.

To my way of thinking, many of the best safety features in the Volvo are not on any list. I'm talking about the way this car can help you avoid accidents. In an emergency, it will respond to the driver's instinctive actions, remaining in control when other cars could get you into trouble.



Front and rear coil-spring suspension units are all new and have no parts interchangeable with other Volvo models. Interior is roomier than in 122-S. Body has thorough rust protection, large glass area, big trunk, doors that open wide, recessed door handles.

# Volvo 144 Really Goes

This is a matter of weight distribution, suspension systems, steering, and brakes all working together.

The 144 also offers excellent protection if an accident does occur. The unit body has extremely strong side posts and special reinforcements to prevent roof cave-in should the car roll over. The front and rear body sections will crumple at a controlled rate on impact without deformation of the passenger compartment. The windshield will pop out on impact from inside. Front seats have three-point harnesses.

Every week I get letters asking me about the Volvo. The most common question is whether Volvo deserves its reputation for quality. Let me answer it this way:

I went through the Volvo plants and saw how they build and test engines and transmissions. I walked along assembly lines. I watched their quality-control men in action. I have driven all over their proving grounds with Volvo's professional rally drivers and taken a tour through the experimental shops and laboratories with top engineers. There is no doubt in my

mind that Volvo is one of the best-built cars in the world. The 144-S is not cheap at about \$3,200, but quality doesn't ever come cheap. **23**

## Facts on the Volvo 144-S

### DIMENSIONS (inches)

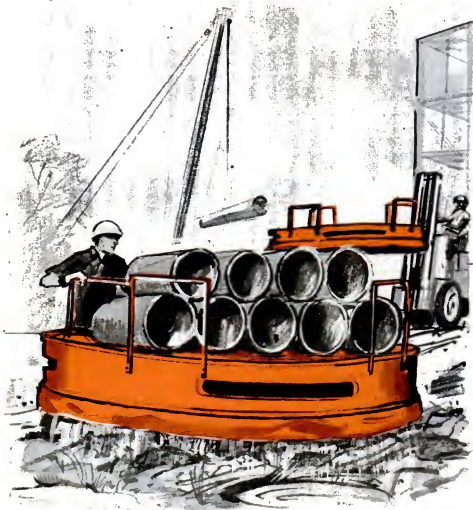
Wheelbase	102.4
Track, front and rear	53.1
Ground clearance	7.1
Length	182.7
Width	68.1
Height	56.7

### ENGINE

Type	OHV four
Displacement	108.5 cu. in.
Bore & stroke	3.313 x 3.15 in.
Compression ratio	10:1
Carburetion	Dual 1-bbl. SU
Power @ r.p.m.	115 @ 6,000
Torque @ r.p.m.	112 @ 4,000

### CHASSIS

Transmission	4-speed all-synchro floorshift (Borg-Warner automatic optional)
Axle ratio	4.56:1
Tire size	165-S x 15
Brakes	4-wheel disk
Turns, lock to lock	4.0
Turning diameter	30.4 ft.
Curb weight	2,735 lb.



## New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMORE

**Cargo pallet rides on air.** Heavy loads might be moved more easily if stacked on this recently patented pallet. It could be moved by forklift, but would also, suspended on air, go in places wheeled vehicles could not. Several blowers in the base, powered from outside through flexible tubes, would compensate for unbalanced loads. The pallet could be handled from any side and would move freely over muddy or rocky surfaces.



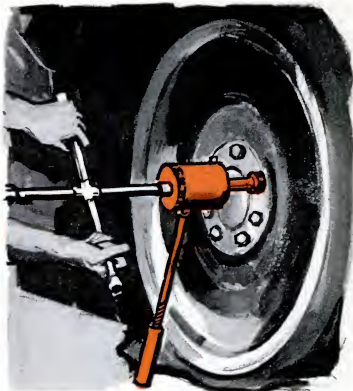
**Magnetic belt collects road markers.** Signal cones used on highways to mark freshly painted stripes and work areas could be collected fast on a conveyor like this. The belt, hauled by a truck, would straddle and topple metal-bottomed cones. Magnets set in the drum on which the belt turns would grip the cones at the bottom and swing them onto the belt. They'd then ride up the belt and drop into the truck.



**Shank lugs lock nail.** Raised spurs on the shank of a nail should give it a better grip on composition materials or on unseasoned lumber, according to this inventor. Spiraled around the shank like a coarse screw thread, the lugs would turn the nail slightly as it was hammered in. Once driven, the spurs would bite in to keep the nail from being loosened by vibration or the drying or shrinking of the lumber.



**Tear strip opens cans.** With a tough, compressible sealing strip like this embedded in the seam of all can lids, you'd never need a can opener or slotted key. Pulling the strip would open the can. It could be inset in the seal of any round aluminum can, but would also permit all cans to be made in square or oblong shapes for easier stacking and nonrolling storage.



**Gears increase tool's torque.** Restrain the casting of this torque multiplier by holding or propping up the projecting handle, and it would increase the turning muscle of a tire tool, brace, or drill. Bevel gears and pinions would reduce the input speed of rotation and deliver a corresponding increase in torque output. Reversed, the tool would trade torque for speed.



**Radio signal "pays" toll.** To speed regular users of a toll facility, this inventor would use a radio signal to control a pass-through light. The signal would be controlled by a counter in the car

transmitter. The counter could be preset and locked by the toll authority—much like a postage meter—so the motorist could prepay the toll for a fixed number of trips.

The following patents have been issued on these inventions: Gem pallet—No. 3,237,708 to R. C. Strasser, Newport News, Va., A. H. Haynes, Anna Maria, Fla., and L. A. Schulte, Hampton, Va.; Magnetic belt—No. 3,232,408 to E. M. Ashbury, Pittsburgh; Spurred nail—No. 3,233,498 to J. A. Handja, Vancouver, B.C.; Can opener—No. 3,268,105 to J. A. Geiger, Washington, D.C.;

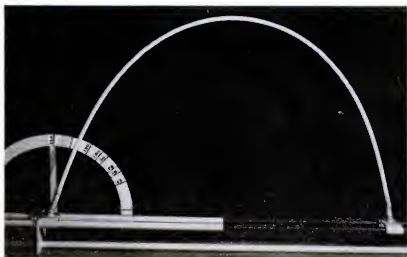
Tool—No. 3,232,149 to N. Duchesne, La Tuque, Que.; Toll signal—No. 3,231,854 to Emile Grau, NYC. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.



Bob Seagren, holder of world's indoor pole-vault record, goes over 16 feet on first vault with new pole.

## New fiberglass pole gives vaulters extra boost

More glass in vaulting poles may help shatter existing records for this exciting event. The "second-generation" fiberglass pole shown above has 15 percent more glass than other poles, which enables it to bend a full 180 degrees without snapping. It gives the pole more flex and greater lifting power. The pole is made by winding over a million continuous glass filaments around the same glass fabric that was used in first-generation fiberglass vaulting poles.

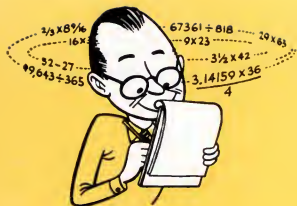


Lab test shows pole bending 140 degrees without breaking.



## STOL plane lands easily on city street in drill

A de Havilland of Canada Twin Otter lands on a New York City street during a recent two-day emergency exercise to prove that STOL (short/vertical takeoff-and-landing) aircraft could support a major metropolitan area in a disaster. The 19-passenger plane, with a 65-foot wingspan, lands in about 625 feet. Shortly after the test, city officials announced a study aimed at turning a pier into a STOL airstrip to handle short-haul air traffic.



## Pull-out Save-it SECTION

# HIGH-SPEED MATH SHORT CUTS

These are a PS editor's choices of the best time-savers for practical, everyday figuring

By ALDEN P. ARMAGNAC

**T**he Editor-in-Chief has asked me to choose and present for your use the best of all the math short cuts, judging from my first-hand experience in using them. And my job of writing and editing PS articles gives me lots of figuring to do.

More than once the assignment of condensing a book on math short cuts, for publication in *POPULAR SCIENCE*, has come my way. I've read numerous texts on the subject. Much of what I edited and read soon took flight from memory.

But quite a number of ways for quicker and easier figuring did stick with me. For, I found, I was regularly taking advantage of them myself in everyday calculations at PS and at home. These short cuts must have passed the test of practical value—and so I'm confident that you'll find them helpful, too.

Also, having studied the principles of math short cuts in general, I've been able to work out a few additional ones that likewise stand the test of daily use.

So here are my choices of the most useful short cuts for figuring:

## ADDING AND SUBTRACTING

### ANSWERS IN YOUR HEAD

I Pay for a \$1.98 purchase with a \$5 bill, and (if there's no sales tax) you know you're going to get at least \$3 back. Perhaps you anticipate that your change will include two pennies, too.

I Probably without realizing it, you've used a handy math short cut. Stop and think how you did it, and you'll find you have a versatile aid for mental figuring.

The \$1.98 price didn't fool you for a moment—you knew it was practically \$2. By subtracting \$2 from \$5, you saw your change would be about \$3. Then, you may have noted, \$1.98 was 2¢ less than \$2—so you should also get 2¢ back, and your change would total \$3.02. Simple? Of course.

**Now to apply it.** This simple trick, only slightly varied, makes it easy to add or sub-

*Continued*

tract other numbers in your head. Like this:

To subtract 27 from 52: Change the 27 to 30. The problem becomes  $52 - 30$ , which obviously gives 22. Now, since you've subtracted too much, add the 3 by which you raised 27. You have your answer: 25.

You've made it simple enough to do in your head, by changing 27 to a nearby round number (just as you changed \$1.98 to \$2.00). In this case, too, it leaves only a single figure to subtract, and removes the mental stumbling block of having to "borrow." And the same trick will eliminate "carrying" in mental addition:

To add 69 and 53: Change the 69 to 70. With only a single figure to add, 7, you see that  $70 + 53 = 123$ . Then revise the total by *subtracting* 1 (the amount by which you raised 69) and the answer's 122.

In the following pages you'll come to ways for multiplying and dividing in your head, too. Already, though, you've seen examples of the principle behind all math short cuts, mental or written:

*Change the problem into an easier one that will give the same answer.* It may be a more roundabout way—but it's an honest-to-goodness short cut if it gets you the answer more easily and quickly.

On paper, adding and subtracting are simple until you have to add an uncommonly long string of figures—or quite a few biggish ones. Knowing that one slip can spoil so much work slows your figuring to a crawl. A good way out is this:

**Adding column-by-column.** Here's a batch of figures added the usual way, and an easier "column-by-column" way. The easy way looks longer but is actually quicker:

Usual way	Column-by-column way
8503	8503
2946	2946
3852	3852
7194	7194
6538	6538
9975	9975
1247	1247
4619	4619
<b>44874</b>	
Total of units column:	44
Total of tens column:	33
Total of hundreds column:	45
Total of thousands column:	40
Grand total and answer:	<b>44874</b>

You add each column separately—units, tens, hundreds, thousands—and put down their sums on successive lines as shown. Then, adding these subtotals gives your answer.

You can work more confidently and therefore faster this way. If you do make a mistake anywhere, it can quickly be found and corrected, and the rest of your work will not have gone for nothing.

## MULTIPLYING

### DOUBLE-AND-HALVE MULTIPLYING

One of my favorite short cuts for multiplying has aptly been called the double-and-halve method. It's as simple as this:

Double one of a pair of numbers to be multiplied, and halve the other. The resulting numbers will give the same product as the original ones—often, much more easily.

To multiply  $16 \times 35$ , the average person would reach for a pencil. But suppose you change the problem to  $8 \times 70$ . The answer, 560, leaps right out at you. Double-and-halving has turned each two-figure number into either a single figure or, just as easy, a single figure followed by 0. It makes the difference between getting the answer in your head and having to use paper.

True, this was an ideal case for double-and-halving, and not every multiplication problem invites this method. But enough do, to make it a useful tool in your kit of short cuts. It will either give you the answer mentally or simplify written figuring in:

- Multiplying by a low, even number of two figures: 12, 14, 16 (as above). Halving it gives an advantageous single figure. Thus, change  $14 \times 31$  to  $7 \times 62$ .

- Multiplying by a number ending in  $\frac{1}{2}$ , if the other is even. Change  $3\frac{1}{2} \times 42$  to  $7 \times 21$  and the fraction is gone. You can do it in your head.

- Multiplying by a number ending in 5, if the other is even. Thus, change  $45 \times 24$  to  $90 \times 12$ .

And a slight variation of double-and-halving removes the last case's restriction that one of the numbers need be even:

**Double now, halve later.** You can double either of the numbers to be multiplied, forget about halving the other, and halve the product instead. For example:

Change  $5 \times 47$  to  $10 \times 47$ , and you get

70; half of that is 235, your answer. Doing this in your head is duck soup.

Similarly  $35 \times 43$  becomes  $70 \times 43$ , which is 3010; and halving this gives the answer: 1505.

## MULTIPLYING PIECEMEAL

Break down a multiplier into a pair of numbers, of which it's the sum or difference is—and you can multiply by them in turn, combining the results. This yields a great variety of ingenious short cuts. To start with the ones that are simplest and so, I think, the best:

**Multiplying by 9.** Nine is the same as  $10 - 1$ , which is much easier to use. Multiply the other numbers first by 10, which means simply appending a 0, or shifting any decimal point one place to the right. Then subtract the other number and there's your answer.

If the problem is  $9 \times 23$ , it goes like this:

$$\begin{array}{r} 10 \times 23: 230 \\ \text{Less } 1 \times 23: - 23 \\ \hline \text{ANSWER: } 207 \end{array}$$

Of course you need write down only the three numbers at the right—if any. In this case the short cut made the problem so easy that you could do it mentally.

You'd multiply by 90 or 900 in just the same way. Simply change 90 to 100 - 10; and 900 to 1000 - 100.

## Multiplying by a near-round number.

Suppose you want to multiply by a number like 29, 38, or 53. These come close to round numbers with only a single figure to multiply by: 30, 40, and 50. So you could make multiplying easier by changing 29 to 30 - 1; 38 to 40 - 2; and 53 to 50 + 3. For example:

To multiply 29  $\times$  63:

$$\begin{array}{r} 30 \times 63: 1890 \\ \text{Less } 1 \times 63: - 63 \\ \hline \text{ANSWER: } 1827 \end{array}$$

To multiply 38  $\times$  72:

$$\begin{array}{r} 40 \times 72: 2880 \\ \text{Less } 2 \times 72: - 144 \\ \hline \text{ANSWER: } 2736 \end{array}$$

To multiply 53  $\times$  64: Breaking down 53 to 50 + 3 looks like conventional multiplica-

tion, which does the same. But, for a short cut, note that 50 is half of 100. You can easily halve 100 times any number, at sight. So:

$$\begin{array}{r} \frac{1}{2} \text{ of } 100 \times 64: 3200 \\ \text{Plus } 3 \times 64: + 192 \\ \hline \text{ANSWER: } 3392 \end{array}$$

## STEPPING-STONE MULTIPLYING

In an attractive refinement of the piece-meal-multiplying short cut, the second step builds on the first. Here are examples:

**Multiplying by 15.** Fifteen equals  $10 + 5$ . The 5 is half of the 10. So all you need do to get your answer is multiply by 10 and add half the result. Thus, to multiply  $15 \times 29$ :

$$\begin{array}{r} 10 \times 29: 290 \\ \text{Plus } \frac{1}{2} \text{ of } 290: + 145 \\ \hline \text{ANSWER: } 435 \end{array}$$

You need write down only the numbers 290, 145, and the answer—it's much quicker than the telling.

**Multiplying by 18, 27, 36.** For these and other multiples of 9, the "stepping-stone" way is ideally suited.

Consider 18 as  $20 - 2$ ; and the 2 as  $1/10$  of the 20. Then, instead of multiplying by 18, you need only multiply by the easy number 20 and subtract  $1/10$  of the result. To multiply  $18 \times 34$ :

$$\begin{array}{r} 20 \times 34: 680 \\ \text{Less } 1/10 \text{ of } 680: - 68 \\ \hline \text{ANSWER: } 612 \end{array}$$

Similarly, change 27 to 30 - 3, and 36 to 40 - 4. Again, after multiplying by the 30 or 40, subtract  $1/10$  of the result.

You'll see other examples below.

## COMBINATIONS OF SHORT CUTS

Singly or combined, these short cuts can simplify almost any number you want to multiply by.

These examples, of what you can change the number to, will also suggest others:

- 25:  $100 \div 4$ . (Multiply by 100; divide result by 4.)  
57:  $60 - 3$ . (Multiply by 60; subtract  $1/20$  of result.) *Continued*

- 75:  $50$  (half of  $100$ ) +  $25$ .  
 126:  $100 + 25 + 1$ .  
 135:  $100 + 50 - 15$ . (Multiply by  $100 + 50$ ; subtract  $1/10$  of result.)  
 182:  $200 - 20 + 2$ . (Multiply by  $200$ ; subtract  $1/10$  and add  $1/100$  of result.)  
 832:  $800 + 32$ . (Multiply by  $800$ ; add  $4/100$  of result.)  
 2178:  $2000 + 200 - 22$ . (Multiply by  $2000$ ; add  $1/10$  of result; subtract  $1/100$  of new result.)

Now, you may be choosy—and so am I—about which of these multiplying short cuts to adopt for regular use.

The very simplest ones are easily remembered and profitably used, for both mental and written figuring. I find fancier tricks less easy to recall in time of need—*unless* they just fit certain particular numbers that recur often in my work. Then, constant use keeps them fresh in memory, and they're a valued help. One example:

In translating technical reports into layman's language, I often have to convert temperatures from degrees Centigrade (the scale used in most scientific work) to degrees Fahrenheit. The way is to multiply by  $9/5$  and then add  $32$ . Since  $9/5$  is  $1.8$ , I can use virtually the same short cut as for  $18$  (I multiply by  $2$ , subtract  $1/10$ ), and speed the task.

Naturally the numbers that recur especially often in *your* work, or in someone else's, may differ from the ones in mine. So here I've stretched a point, from sticking to short cuts I use myself, to include a little wider selection where you may find just the ones for the "special numbers" in your life.

## DIVIDING

### DOUBLING THE NUMBERS

In our school days we learned to cut down numbers' sizes as much as we could, before dividing. If we had to divide  $1,226$  by  $14$ , we halved each number and had  $613 \div 7$ —which could be done by short division.

But doing just the opposite—doubling each number, once or more—will simplify some problems, and may even make the dividing easy enough to do in your head.

A tidbit of history in my newspaper today offers a perfect example: Back in 1637 when

New York was New Amsterdam, a census showed there were  $700$  inhabitants and  $25$  taverns. How many people were enough to keep a tavern going? Mentally doubling the numbers eases the problem to  $1400 \div 50$ ; once more, and it's an even simpler  $2800 \div 100$ , which instantly satisfies your curiosity with the answer:  $28$ .

Keep your eyes open and you'll recognize when this short cut will aid in dividing. The numbers simplified by doubling are the same ones as in multiplication:  $5$ ,  $50$ , and numbers ending in  $5$  or in  $1/2$ .

### AWAY WITH LONG DIVISION

My advice to those about to do long division is: DON'T.

Such a chore is long division—a laborious, time-consuming process of trial and error—that it would be worth going to almost any length to avoid it.

Simple tricks like the preceding ones will spare us from it in a few fortunate cases, but not in most. And when we do come to long division, where we need a short cut most of all, most writers on short cuts seem to throw up their hands.

The best short cut of all would be a way out of any long-division problem whatever.

And we can have it, if we'll be satisfied with an approximate answer—one that comes out either on the nose, or close enough to it for practically all everyday figuring. (Conventional long division, itself, seldom gives an exact answer—we stop when we have a close-enough one, perhaps of three or four figures.)

### HOW TO AVOID LONG DIVISION

Here is a short cut that ends long division *by turning it into multiplication*—a novel way to make an easier task of it. Yet it's such a logical and almost obvious way that I'm surprised I've never seen it described elsewhere, and had to hit on it myself.

If you want to divide any number by, say,  $273$ , that is precisely the same as multiplying the number by  $1/273$ . To divide by  $596$ , you could just as well multiply by  $1/596$ . And the fractions can be put in decimals.

Naturally that would get you nowhere if you had to calculate the decimal value of  $1/273$  or of  $1/596$ , yourself. But by good fortune, it's already been done for us.

labor-saving table is the key. Our wonder-working aid is what mathematicians call Table of Reciprocals. Neatly arranged in columns are the answers to dividing 1,000 by every number from 1 to 999. The answers are given to six figures, in one of the reference handbooks I keep within arm's reach, and to seven figures in another. On the next two pages appears a version of this table more convenient for the present purpose, in which the values are rounded off to four figures. Of course, what this table amounts to is the answer to dividing 1 by every number—which you get simply by shifting the decimal point three places to the left. (The table's compiler chose 1,000 just to avoid having to precede most values with a decimal point and zeros.

Having this much already, you can get an approximate answer to any long-division problem by easy and straightforward multiplication. Let's see how it works, and how close the answer comes.

**works like this.** If a man earns \$9,643 a year, what is his average daily income? Here's what would ordinarily be a tedious long-division problem:  $\$9,643 \div 365$ . Instead, we change it to  $\$9,643 \times 1/365$ —and turn to our table.

Opposite 365 we find 2.740, by which we now multiply \$9,643, taking care to shift the decimal point three places leftward before we're through:

$$\begin{array}{r} \$9\ 643 \\ 2.740 \\ \hline 385\ 720 \\ 6\ 750\ 1 \\ 19\ 286 \\ \hline \$26,421.820 \end{array}$$

Retain just the first four figures (all that could be kept in this method) and our answer, rounded to the nearest cent, is: \$26.42. By conventional long division (which gives \$26.419 . . .), our rounded answer would be just the same.

Doing it our way, we put down fewer figures, and were spared the frustration of guessing wrong in such agonizing long-division decisions as, "Will 365 go into 2343 seven times, or only six?" In our way, all is clear sailing, and no question or hesitation about it.

**Round number makes short-cut way shine.** Our short cut looks even better when, as often happens in real-life problems, we have a round number to divide. Suppose we want to divide 11,000 by 293. The round number wouldn't help a bit in long division, but see what happens in our way. For 293, the table gives 3.413. We can just as well shift the decimal point beforehand, by changing 11,000 to 11, and this is all that's left to do:

$$\begin{array}{r} 3.413 \\ 11 \\ \hline 3\ 413 \\ 34\ 13 \\ \hline 37.543 \end{array}$$

Keeping four figures, the answer is 37.54. (Long division gives 37.542 . . ., which rounds to the same.)

We won't always come quite so close—remember, this is an approximate method. Let's try another one:  $67,361 \div 818$ . For 818 our table gives 1.222—they're sometimes that easy!—and so we have:

$$\begin{array}{r} 67\ 361 \\ 1.222 \\ \hline 134\ 722 \\ 1\ 347\ 22 \\ \hline 13\ 472\ 2 \\ 67\ 361 \\ \hline 82.315142 \end{array}$$

Rounding this to four figures gives the answer as 82.32. By long division we'd get 82.348 . . ., or a rounded 82.35. So our final figure was off by 3 (in more than 8,000)—reasonably little in a number this big.

The short cut is approximate because few of the reciprocals' values come out exactly in the four figures of this table—or even in six or seven figures, for that matter. So rounding off these values introduces small errors. They become most noticeable, when the first figure of the divisor or the answer ranges up into 8 or 9; least, when it is low.

**How close?** Just how accurate, then, is this method? The answers, a study shows, will range from at least 99.94% up to 100% accurate. They come twice as near to exact, as the answers I can get with a slide rule—an engineer's favorite short cut. So they should be good enough for all ordinary purposes.

**Short-Cut Table on next two pages; text continued on page 126**



# USE THIS SHORT-CUT TABLE

ate, ranging from 99.94% to 100% accurate. Maximum possible error in last figure, 5; usually much less, if any.)

For completeness, this table includes all

numbers from 1 to 999, although the divisors 1 to 10 and some others would not require long division. For what to do with divisors larger than 999, see text, next page.

$\frac{1000}{n}$	n	$\frac{1000}{n}$	n	$\frac{1000}{n}$	n	$\frac{1000}{n}$	n	$\frac{1000}{n}$	n	$\frac{1000}{n}$	n	$\frac{1000}{n}$	n	$\frac{1000}{n}$	n
1.783	631	1.585	701	1.427	771	1.297	841	1.189	881	1.135	921	1.086	961	1.041	
1.779	632	1.582	702	1.425	772	1.295	842	1.188	882	1.134	922	1.085	962	1.040	
1.776	633	1.580	703	1.422	773	1.294	843	1.186	883	1.133	923	1.083	963	1.038	
1.773	634	1.577	704	1.420	774	1.292	844	1.185	884	1.131	924	1.082	964	1.037	
1.770	635	1.575	705	1.418	775	1.290	845	1.183	885	1.130	925	1.081	965	1.036	
1.767	636	1.572	706	1.416	776	1.289	846	1.182	886	1.129	926	1.080	966	1.035	
1.764	637	1.570	707	1.414	777	1.287	847	1.181	887	1.127	927	1.079	967	1.034	
1.761	638	1.567	708	1.412	778	1.285	848	1.179	888	1.126	928	1.078	968	1.033	
1.757	639	1.565	709	1.410	779	1.284	849	1.178	889	1.125	929	1.076	969	1.032	
1.754	640	1.563	710	1.408	780	1.282	850	1.176	890	1.124	930	1.075	970	1.031	
1.751	641	1.560	711	1.406	781	1.280	851	1.175	891	1.122	931	1.074	971	1.030	
1.748	642	1.558	712	1.404	782	1.279	852	1.174	892	1.121	932	1.073	972	1.029	
1.745	643	1.555	713	1.403	783	1.277	853	1.172	893	1.120	933	1.072	973	1.028	
1.742	644	1.553	714	1.401	784	1.276	854	1.171	894	1.119	934	1.071	974	1.027	
1.739	645	1.550	715	1.399	785	1.274	855	1.170	895	1.117	935	1.070	975	1.026	
1.736	646	1.548	716	1.397	786	1.272	856	1.168	896	1.116	936	1.068	976	1.025	
1.733	647	1.546	717	1.395	787	1.271	857	1.167	897	1.115	937	1.067	977	1.024	
1.730	648	1.543	718	1.393	788	1.269	858	1.166	898	1.114	938	1.066	978	1.022	
1.727	649	1.541	719	1.391	789	1.267	859	1.164	899	1.112	939	1.065	979	1.021	
1.724	650	1.538	720	1.389	790	1.266	860	1.163	900	1.111	940	1.064	980	1.020	
1.721	651	1.536	721	1.387	791	1.264	861	1.161	901	1.110	941	1.063	981	1.019	
1.718	652	1.534	722	1.385	792	1.263	862	1.160	902	1.109	942	1.062	982	1.018	
1.715	653	1.531	723	1.383	793	1.261	863	1.159	903	1.107	943	1.060	983	1.017	
1.712	654	1.529	724	1.381	794	1.259	864	1.157	904	1.106	944	1.059	984	1.016	
1.709	655	1.527	725	1.379	795	1.258	865	1.156	905	1.105	945	1.058	985	1.015	
1.706	656	1.524	726	1.377	796	1.256	866	1.155	906	1.104	946	1.057	986	1.014	
1.704	657	1.522	727	1.376	797	1.255	867	1.153	907	1.103	947	1.056	987	1.013	
1.701	658	1.520	728	1.374	798	1.253	868	1.152	908	1.101	948	1.055	988	1.012	
1.698	659	1.517	729	1.372	799	1.252	869	1.151	909	1.100	949	1.054	989	1.011	
1.695	660	1.515	730	1.370	800	1.250	870	1.149	910	1.099	950	1.053	990	1.010	
1.692	661	1.513	731	1.368	801	1.248	871	1.148	911	1.098	951	1.052	991	1.009	
1.689	662	1.511	732	1.366	802	1.247	872	1.147	912	1.096	952	1.050	992	1.008	
1.686	663	1.508	733	1.364	803	1.245	873	1.145	913	1.095	953	1.049	993	1.007	
1.684	664	1.506	734	1.362	804	1.244	874	1.144	914	1.094	954	1.048	994	1.006	
1.681	665	1.504	735	1.361	805	1.242	875	1.143	915	1.093	955	1.047	995	1.005	
1.678	666	1.502	736	1.359	806	1.241	876	1.142	916	1.092	956	1.046	996	1.004	
1.675	667	1.499	737	1.357	807	1.239	877	1.140	917	1.091	957	1.045	997	1.003	
1.672	668	1.497	738	1.355	808	1.238	878	1.139	918	1.089	958	1.044	998	1.002	
1.669	669	1.495	739	1.353	809	1.236	879	1.138	919	1.088	959	1.043	999	1.001	
1.667	670	1.493	740	1.351	810	1.235	880	1.136	920	1.087	960	1.042			
1.664	671	1.490	741	1.350	811	1.233									
1.661	672	1.488	742	1.348	812	1.232									
1.658	673	1.486	743	1.346	813	1.230									
1.656	674	1.484	744	1.344	814	1.229									
1.653	675	1.481	745	1.342	815	1.227									
1.650	676	1.479	746	1.340	816	1.225									
1.647	677	1.477	747	1.339	817	1.224									
1.645	678	1.475	748	1.337	818	1.222									
1.642	679	1.473	749	1.335	819	1.221									
1.639	680	1.471	750	1.333	820	1.220									
1.637	681	1.468	751	1.332	821	1.218									
1.634	682	1.466	752	1.330	822	1.217									
1.631	683	1.464	753	1.328	823	1.215									
1.629	684	1.462	754	1.326	824	1.214									
1.626	685	1.460	755	1.325	825	1.212									
1.623	686	1.458	756	1.323	826	1.211									
1.621	687	1.456	757	1.321	827	1.209									
1.618	688	1.453	758	1.319	828	1.208									
1.616	689	1.451	759	1.318	829	1.206									
1.613	690	1.449	760	1.316	830	1.205									
1.610	691	1.447	761	1.314	831	1.203									
1.608	692	1.445	762	1.312	832	1.202									
1.605	693	1.443	763	1.311	833	1.200									
1.603	694	1.441	764	1.309	834	1.199									
1.600	695	1.439	765	1.307	835	1.198									
1.597	696	1.437	766	1.305	836	1.196									
1.595	697	1.435	767	1.304	837	1.195									
1.592	698	1.433	768	1.302	838	1.193									
1.590	699	1.431	769	1.300	839	1.192									
1.587	700	1.429	770	1.299	840	1.190									

EXAMPLE: Divide \$8,654 by 568

SOLUTION:

$$\begin{array}{r} \$8,654 \\ \times 1.761 \end{array} \quad (\text{from table})$$

$$\begin{array}{r} 8\ 654 \\ 519\ 24 \\ 6\ 057\ 8 \\ 8\ 654 \end{array}$$

Move decimal point  
3 places to left

$$\underline{\$15,239.694}$$

Keep first 4 fig-  
ures, rounding 4th

ANSWER: \$15.24

This is the same answer you get, to the nearest cent, by long division.

While this is an approximate method, the answer is always at least 99.94% accurate; usually, much better.

**Dividing by larger numbers.** Divisors in everyday problems usually fall within the table's up-to-999 range, but it can be used for larger ones, too.

For four-figure divisors, an example will best show how. To divide by 3562, consider it as 356.2. Obtain the difference between the table's values for 356 (2.809) and 357 (2.801), which is .008. Multiply .008 by the .2 at the divisor's end, giving .0016; and subtract this from 2.809. This gives a five-figure 2.8074 to multiply by. (Whenever this procedure gives more than five figures, round them to five.) In the answer, move the decimal point an extra place to the left; keep four figures as usual. Thus a four-figure divisor makes a little more work, but so it does too in long division.

Divisors of five figures or more can be handled the same way (consider 35623 as 356.23); or, usually at little cost in accuracy, rounded to four figures (consider 35623, like 3562, as 356.2). Shift the decimal point in the answer an extra place leftward, of course, for every additional figure in the divisor.

## A FEW OTHER TIPS

It will speed your figuring to steer clear of awkward numbers, such as unwieldy fractions. They're spawned in profusion by our illogical way of splitting a foot into 12 inches, and an inch into 8ths, 16ths, and 32nds. But here's an example of sidestepping them:

**Scaling problems.** Suppose you're altering the scale of measurements, upward or downward. That may happen in making a scale model, or in changing plans for a build-it-yourself item to a different and preferred size. For me, the problem arises when I want to sketch a reasonably faithful copy of a simple mechanical drawing, on an enlarged or reduced scale.

If measurements are to be reduced to  $\frac{3}{4}$  of the original size, how would you go about it, say, for  $8\frac{1}{16}$ "?

If you naively tackle it head-on and multiply  $\frac{3}{4} \times 8\frac{1}{16}$ "—and I've done just that, before learning better—you'll come up after quite a while with a dismaying  $5\frac{17}{24}$ ". Since your ruler or scale can't measure that kind of a fraction, you'll then have to convert the  $17/24$  into something a ruler *can* measure, like 16ths. It can be done, if you perse-

vere, but it would certainly be the hard way!

The easy way is to forget about inches—until your figuring is done. In making the measurements, consider a scale's smallest graduations—16ths on my dime-store ruler—as *units*. Then,  $8\frac{1}{16}$ " becomes 137 units. And  $\frac{3}{4}$  of it, to the nearest unit, is 91 units. So the wanted dimension is  $\frac{91}{16}$ " or  $5\frac{1}{16}$ ".

The smaller the units, the more accurate the scaling. You may prefer to use a scale graduated in 32nds of an inch—or in millimeters, as I do, using the metric scale on the opposite side of my dime-store ruler. Since the metric scale is a decimal one, it saves the minor nuisance of steps like changing  $\frac{91}{16}$ " back into  $5\frac{1}{16}$ ".

**"Squaring" a circle.** Another awkward number—*pi*, variously used as  $3\frac{1}{7}$ , 3.14, or 3.1416—obtrudes itself when we want to know a circle's area, or the capacity of a cylindrical tank. But, to find the *approximate* area of a circle (accurate to about  $\frac{1}{2}$  of 1%), you need remember only one simple number:

A circle's area is about 21% less than that of a square that just encloses it—in other words, whose side is equal to the circle's diameter.


Thus the area of a 6-foot-diameter circle will equal that of a 6-foot square—36 sq. ft.—less approximately  $.21 \times 36$  or 7.56 sq. ft. If you just want to know the answer to the nearest square foot, it's 28 sq. ft.—and that's as good an answer as if you'd taken *pi* to as many figures as 3.14159, and used the conventional formula that a circle's area is  $\frac{\pi}{4}$  the product of *pi* times the square of the diameter.

And the check I made to verify that last statement gave an unexpected example of the usefulness of these pages' short cuts. The problem was:

$$\begin{array}{r} 3.14159 \times 36 \\ 4 \end{array}$$

and so could be reduced to  $9 \times 3.14159$ . And to multiply by 9, you remember, you need only multiply by 10 and subtract the number itself. So this was all there was to do:

$$\begin{array}{r} 31.41590 \\ - 3.14159 \\ \hline 28.27431 \end{array}$$

Save yourself, too, time and trouble with these short cuts—and happy figuring! 



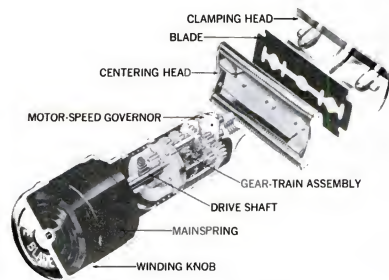
Multiple-exposure photo above shows Camelot Deluxe camper rising to full height of six feet, seven inches.

### Pushbutton raises camper's roof

Nimrod's '67 Camelot camper gives outdoor living a lift with an automatically operated expansion device. A flick of a switch starts an electric motor, which raises the top and slides out two beds, creating a 20-foot-long living area. The camper also has a 6½-foot-long kitchen with a three-burner stove, stainless-steel sink, and a linette that converts into a third bed. The \$1,599 camper has foot-operated leveling jacks at each corner. Nimrod Div., Ward Manufacturing, 500 Ford Blvd., Hamilton, Ohio 45011.



Pushbutton operation sets up the camper in seconds.



### Spring-driven razor has "live" blade

The wind-up spring drive of this razor makes standard double-edge blade vibrate more than 5,000 times a minute to ease cutting whiskers.



The movement of the blade produces a slicing action, which is claimed to give a closer shave than electric razors. But it's used with lather just like a regular safety razor. Cost: \$25. Stahly, Inc., 1811 St. John's Ave., Highland Park, Ill.

# NEW PRODUCTS FOR



**Decorative shower enclosure** for your tub is installed in an hour using this new system: a flexible plastic panel sliding inside an aluminum frame. The doors fold like an accordion to less than eight-inches wide; open and close from either end. Kits have all you need for installation, including instructions, hardware, and mastic. They come in nine colors, in sizes to fit any tub. Showerfold Door Corp., 5858 N. Pulaski Rd., Chicago 60646, is the manufacturer.



**Free-standing fireplace** is made of new space-age ceramics that let you safely put it within five inches of any wall. Called the Aztec, the fireplace comes in five colors: Inca gold, bronze green, Mandarin red, burnt orange, and desert sand. The screen, flue sections, and spun-steel base are matte black. It has a seven-inch flue that connects easily to any chimney approved for solid fuel. Made by Condon-King Co., 5611 208 Ave. S.W., Lynnwood, Wash.

## Now you can get Early American hardware for outside doors and gates

If your inside hardware is Early American, don't switch to another style outside. Now you can get matching hardware to outfit wood or metal doors. Kits for storm and screen doors (below, left) with everything you need—hinges,

latch, closer, protector chain—are being offered by Ideal Brass Works, Red Bank, N.J. Hardware for gates, tool sheds, and carports in Stanley's new line (below, right) include a gate latch, thumb latch-set, tee hinge, strap hinge, spring,



# IMPROVING YOUR HOME



**Cabinet panels reverse** to let you change your kitchen decor in the new Tappan Designer line of kitchen cabinets. One basic cabinet line lets you design a variety of distinct kitchens. The plastic-laminate panels are finished in many colors, textures, designs, wood grains, and even with carved emblems for a Spanish flavor. Contemporary designs, or an Oriental motif as shown above, are a few possibilities. Tappan Co., Mansfield, Ohio, is the maker.



**Do-it-yourself divider** features a plastic panel resembling antique glass that fits into its pre-finished wood frame. Panels come in 26 colors and designs. Standard size is two-by-six feet; spring-loaded frame supports adjust to ceiling heights of up to 106 inches without alteration. All parts are precut, and only four holes need be drilled. K-Lux Products, 10091 Manchester, St. Louis 63122, makes the divider in single, double, and triple units.



**Cabinets with picture-frame trim** give a decorative accent to bathrooms. They come with a sliding or hinged plate-glass mirror door, carved-wood frame, and a sturdy, all-welded steel cabinet body that is recessed into the wall. F. H. Lawson Co., Cincinnati 45204, is the maker.



**Nine-in-one kitchen appliance** mixes, blends, beats, squeezes, grinds meat, mills coffee, shreds salad, sharpens knives and scissors, crushes ice. Just switch attachments. The Foodmatic also has an infinitely variable speed control. It's made by Ronson Corp., Woodbridge, N.J.



### Tiller extension permits safer steering

A handle extension on your outboard motor lets you stand up when in strange or treacherous waters and gives you more sensitive control. Cut an 18" length of 1½" plastic pipe, heat one end in boiling water, and force the pipe over the handle. Locate and drill a hole in the pipe before mounting it so you can loosen the setscrew that holds the handle.

JACKSON HAND, Westport, Conn.

## BOATING



### Padlock protects anchor

Your anchor won't be stolen if you secure it to the mooring bitt with a bicycle lock. Attach a length of chain permanently to the anchor head, wrap the chain around the mooring bitt, padlock as shown.

R. LUMACHI, Brooklyn, N.Y.



### Trailer rolls on nose wheel

Pushing your boat and trailer from one part of the yard to another is a snap with this easy-to-make wheel. Bolts running through the base of a 3" rubber-tired caster and through two squares of ¾" plywood form a clamp around the trailer tongue; wing-nuts allow fast mounting and removal.

G. HANDSAKER, Redondo Beach, Calif.



### Front hitch pulls trailer up slippery ramp

A slippery launching ramp may make your car's rear wheels spin when you try to haul out your boat and trailer. An easy fix is mounting a trailer hitch on your front bumper. Your car will get better traction because the rear wheels are farther away from the water, where the ramp is dry. An auto-supply store can sell you all the necessary parts except for the flat plate that bolts to the bumper; have a welder make up this plate and weld it to the towing-ball assembly.

ROY PAGE, Carlsbad, N.J.

# IDEAS from PS Readers



## Bowline anchor prevents bumping

To keep waves from banging a small boat against the dock, tie the stern as usual, but hang an anchor on the bowline; tension will hold the boat tight against the dock. Use this trick even with bumpers; it will eliminate the noise that keeps camper-cottagers awake nights.

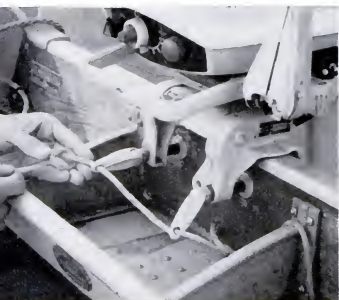
MORTON MILES, Seattle.



## Dishpan for anchor keeps boat tidy

Storing your small-boat anchor in a plastic dishpan from the five-and-dime helps keep your boat clean and dry. Any water, sand, or mud on the anchor drains into the pan, which is easily rinsed. Keep the anchor ready for use by coiling the rope in the pan as shown above.

R. F. HOPKINS, Eau Gallie, Fla.



## Nylon rope secures outboard motor

To keep your outboard motor from falling off, rig up a simple security line from braided-nylon rope. Tie one end of the rope to the boat and slip the other end through both screw handles after they have been tightened. Then tie a knot in the loose end of the line. This not only holds the motor in case it slips off; it helps prevent the screw handles from turning.

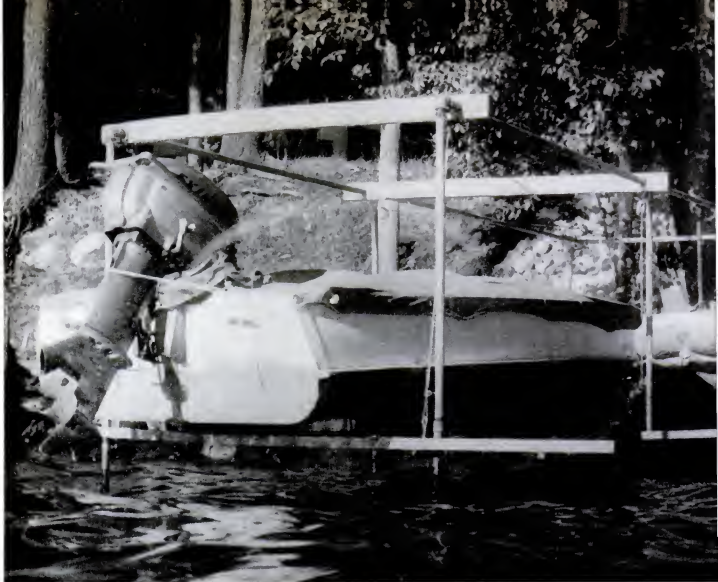
WILL OSBORNE, Chicago.



## Plastic line locates buoy anchor

When you take in your mooring buoy, there's no need to pull up the anchor—especially when it's a washtub full of concrete. Simply tie some polyethylene line (which won't rot) to the aluminum chain; the chain sinks, but the line floats. Use just enough line so its end floats a few feet below the surface. To hook up the buoy, just pull in the line and chain.

JACKSON HAND, Westport, Conn.



PS BOATING

## Small-Boat Hoist

**N**o matter how securely your small boat is tied and fendered to the dock, its hull can suffer severe damage from wind and waves. A far better way to store the boat is above the water in a hoist.

Using the hoist shown here is as simple as parking your car in a garage. It was built by Vance Crawford of Lake George, N.Y., for his 12-foot runabout, but the dimensions can be stretched to take up to an 18-foot hull. The entire rig pivots out of the water in winter time.

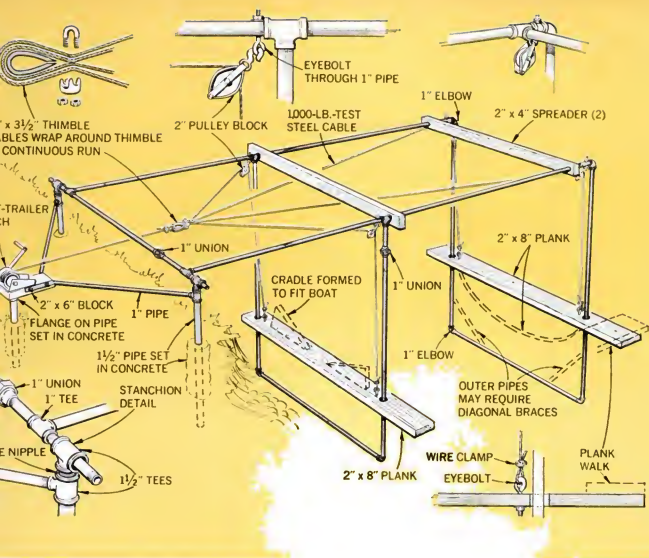
To build it you need only some galvanized pipe, cable, fittings, a few pieces of lumber, and a boat-trailer winch. Start by selecting a solid location for the 1½" pipe stanchions shown in the diagram. Then, considering the contour of the bottom and the length of your boat, determine how far your rig must extend into the water. At that point, measure from the bottom to a height sufficient to give your boat clearance above the water and below the top

of the frame. This is the length required for the first pair of 1" vertical pipes.

At a point about halfway back to the pipe-stanchion position, measure again from the bottom to where the top of the frame will be to determine the length of the second pair of vertical pipes. Finally, determine the necessary width, and have 1" galvanized pipe cut to the proper lengths to form the basic framework. Have the pipes tapped at each end and assemble the frame—essentially a pair of U's connected by horizontal pipes, by means of tees and elbows. Include in your assembly the spreaders in the middle and at the far end; these can be two-by-fours or pipe.

Next, lower the framework into the water; if it doesn't rest solidly, you may need to smooth the bottom. If the bottom is soft, attach planks to the bottoms of the U's with pipe clamps. This prevents too much settling and adds rigidity as well.

When you install the pipe stanchions,



## You Can Build By HANK CLARK

make sure the tee fitting at the top of each stanchion is perfectly level with the horizontal members of the framework. Then connect the two horizontal members with a length of 1" pipe, extending the ends of the pipe through the stanchion tees. You will need union joints here and on the U's.

Swing the rig back up on shore and install the two-by-eight plank lifts on each set of vertical pipes. The shoreward plank should have a V-shaped cradle to steady the bow of your boat. Making the planks longer on one side allows them to hold a plank walk.

On the longer horizontal pipes, just to the shoreward side of each vertical U assembly, drill four holes, install 3" eyebolts, and attach 2" pulley blocks with hooks. Four more eyebolts go in the lifting planks, just inside the vertical pipes.

Next you need three lengths of 1,000-pound-test, 3/16" stainless-steel cable. Attach two of the lengths to the lifting planks

with wire clips and nuts, starting at one plank eyebolt, running up through the pulley, around a 3/4"-by-3 1/2" rope thimble, back through the opposite-side pulley, and down to the opposite eyebolt in the same lifting plank. With cables attached, lower the framework into the water.

The last step is installing the winch and running the third length of cable from the winch to the thimble. The winch must be far enough back from the hoist to allow the boat to be lifted clear of the water before the thimble reaches the winch. Set the winch in concrete or secure it to a tree or other handy solid object.

Make sure the U's rest solidly on the bottom. Use shims to correct any slight misalignment. Then take up on the wire clips, since they will wear in after lifting the boat a few times.

Now when winds howl and waves batter your shoreline, your boat will be high and dry—and safe.

## WHAT'S NEW

### BOATING

#### Fast-dry paint protects hulls from fouling

Dripless paints of latex consistency have moved out of the living room and onto the bottoms of boats, promising mariners a powerful new weapon against fouling.

In tests made in the subtropical aggressively fouling environment of Biscayne Bay, Fla., panels coated with the dripless paint are said to have remained clean after eight months of immersion; test panels coated with two popular conventional bottom paints were completely fouled after two and five months respectively.

Boat owners whose craft have been protected for up to three seasons by the new paint report clean underwater surfaces. A New York marina manager who raised a sunken runabout after it

had spent six weeks on the bottom found the entire boat fouled with barnacles and grass—except for the hull, which had been coated with the new paint.

Developed by the Chilton Paint Co., College Point, N.Y., the paint is said to be effective on wood, metal, and fiberglass hulls. Boats can be launched immediately after painting.



#### '67 Glasspar Avalon: designed for families

Most features you want in a family fun boat are combined in the new Avalon 16-foot fiberglass runabout. It comes with either outboard or inboard-outboard power and has an 18-gallon built-in gas tank, mechanical steering, and sun-lounge seats as standard equipment. The outboard version sells for \$1,095; the 80-hp. stern-drive version is \$2,945. The manufacturer is Glasspar, Santa Ana, Calif.



#### Chrysler-powered Cobia is a lively performer

This big open-water boat has bunk space forward, a skiff-type windshield, and a spacious cockpit aft for partying. Powered by Chrysler's 210 inboard-outdrive, its fiberglass hull will do 42 m.p.h. The 24-footer, called the Offshore, is built by Cobia Boats, Stanford, Fla.



# PHOTOGRAPHER'S GRAB BAG: gadgets, gizmos, and gimmicks

By PAUL WAHL



**A**ll you really need to take pictures are a camera, film, and a subject. Gadgets may not be absolutely necessary, but they do make picture-taking easier, enable you to get shots that might otherwise be impossible, and add fun and interest to your hobby. On this and the following two pages, you'll find a mixed bag of fascinating items for the camera fan—things to buy, things to make, and some ways of putting common home and shop items to use.

## Variable-power close-up lens

Mounted on a 35mm SLR, the Proxivar gives a continuously variable focusing range from 40" to 4" with the camera lens at infinity. For extreme close-ups, the Proxivar is focused for desired image size. It does not affect exposure or automatic diaphragm operation. Proxivar sells for \$15.95 from Spiratone, Inc., 135-06 Northern Blvd., Flushing, N.Y. 11354.



## Poor-man's "fisheye lens"

A true fisheye lens costs over \$400. For about \$5 and 10 minutes' time, you can make an auxiliary lens that, mounted on your camera's normal lens, approximates the 180-degree view and weird effects of the real thing. Components are a wide-angle door peephole and a lens cap. Drill a hole in the cap, insert the rear tube of the viewer, and cement in place. *Continued*





### Shoot yourself with a Swinger

Like to be in the picture the next time you shoot with your Polaroid Swinger camera? You can, with this Kalimar kit. It includes a self-timer, a shutter-release adapter (to permit use of a standard cable release), and a bracket for tripod mounting. The kit, which sells for \$5.95 at camera stores, is distributed by Kalimar, Inc., 2644 Michigan Ave., St. Louis, 63118.



### More bounce in your flash

Reflectorless flash delivers soft, natural-looking light, combining the advantages of bounce and direct flash. Lumin Bare Bulb B-C Flashgun (for M-5 bulbs), from John Murray, Murrayhill West, Pewaukee, Wis., costs \$8. Prefer strobe? Aimes-Hershey, Box 73, Lockport, Ill., offers Hershey Bare Tube Flash Head (for use with 450-volt power packs) at \$49.95.



### Put slaves to work for you

Multiple flash, without a tangle of connecting wires, is easy with this electric-eye slave unit. Light from the flash on your camera strikes its photocell, causing it to set off almost any flash or strobe unit. A screw socket adapts the slave to any tripod with standard  $\frac{1}{4}$ -20 screw. Any number of slave units can be used. They're \$9.95 each from Spiratone.

### Want a projection screen for a dollar?

At a buck or less, you can't beat a sheet of white, smooth-surface mat board as a low-cost projection screen. It comes in an ideal 30-by-40-inch size, is a standard item with art-supply dealers. It also doubles as a light reflector or as a background for close-ups.

### Copying Polaroid shots with a Polaroid

Polaroid Copy Service makes copies at modest prices, but there are times when you want extra prints right away. Now you can do it yourself with this copying attachment. A supplementary lens makes same-size copies (and works on close-ups, too). PSI Copier for Polaroid Models 100 and 101 costs \$19.95 from Gatchel's, 5th and Walnut, Louisville, Ky. 40202.

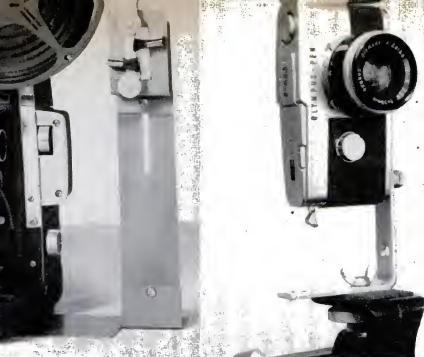
### Forget your meter? Try this rule-of-thumb

Here's a reliable formula for outdoor exposures—it works with any film. Paste it in your camera case. Set your shutter at a speed equal to 1/ASA film speed. In bright sun, set lens aperture at  $f/16$ ; cloudy bright,  $f/8$ ; heavy overcast or open shade,  $f/5.6$ .

### How to put stars in your pictures

A piece of window screen over your lens adds drama to night pictures by putting a four-pointed star around each bright light in the scene. Just cut out a round piece of screen to fit in an adapter ring. For eight-pointed stars, use two pieces of screen. Similar effects are created by the Spiratone Crostar (Series VII, \$4.84; Series VIII, \$8.84) available from Spiratone.





### Automatic film cleaning

You can clean your movie film automatically, while you project—with the Lindau 8mm Electrostatic Film Cleaner. Film moves from the reel over nylon rollers and between a pair of brushes, static-charged brushes that remove surface dust and dirt electromagnetically before it enters the projector. Lindau Film Sales, Box 483, Lake Forest, Ill. 60045.

### Angle bracket for vertical shots

If your tripod won't hold your 35mm camera in position for vertical shots, buy an angle bracket at the hardware store. Three-inch size is right for most cameras. Attach it to the tripod screw with a  $\frac{1}{4}$ -20 nut and mount the camera to the upright leg with a  $\frac{1}{4}$ -20 screw cut to size. To avoid marring the camera baseplate, cement a piece of felt on the bracket's vertical leg.



### How to choose a strap

A good camera strap should be light but strong, be readily adjustable for length, have a pair of sturdy split rings to secure it to camera eyelets. Strap-ateer meets these requirements, also has a luggage snap and ring for easy removal of camera when you wear it slung under your coat. It's \$3.50 from Strap-ateer, 6626 S. Lafayette St., Littleton, Colo. 80120.

### No-cost blower for camera cleaning

To get dust off lenses or out of cameras, don't wipe—blow. An empty squeeze bottle of the type used for nasal sprays—or an ear syringe, available at your drugstore—makes a good blower. Needless to say, it must be thoroughly washed out and dried before using.

### Belt reel for meter or camera

A handy, ready-for-action way to carry an exposure meter or small, lightweight camera is with the Key-Reel, which clips on your belt. A split O ring attaches meter or camera by its eyelet to the spring-back chain. You may want to replace the key ring with a smaller split ring. You can get a Key-Reel for approximately \$2 at hardware and stationery stores.

### Best way to store film—keep it cool

Best place to keep your film supply is in the family refrigerator—it will add months to the film's expiration date. Films stored in a freezer at zero or below will keep for several years. After removal, allow the films to reach room temperature before opening the packages.

### Tape-on guide figures flash exposure

Calculating flash exposures on a Rolleiflex is a cinch with a Guide-Tel—an adhesive strip with a calibrated  $f$ /scale—taped around the focusing knob. Correct  $f$ /number is read opposite the focusing mark. Guide-Tel (for 75mm or 80mm lenses) is a set of six tapes for guide numbers from 40 to 110. It's \$1 from Photomobile, 2264 Electra, Rowland Heights, Calif. 91745. **[S]**



# How to Fix Those Dents

**With the right tools  
and a little skill,  
you'll find many body  
repairs easy to make**

By JOHN BURROUGHS

**A**uto-body repair is a skilled trade. Can a weekend mechanic with no experience at bodywork repair a dent in his car with hand tools and wind up with a satisfactory job on his first try? Yes—if the damage is not too extensive or complex.

Restoring a body that's badly smashed calls for hard and painstaking work, and highly specialized tools. Rebuilding and realigning a wreck takes a shopful of hydraulic body jacks, clamping fixtures, and welding equipment. Straightening a dent is something else. It's a fairly simple job with the proper hand tools.

**What tools?** The basic body and fender hand tools needed for simple body-repair jobs—a body hammer, dolly, spoon, and body file—will cost around \$15.

Hammers, dollies, and spoons come in

various patterns. A light bumping-picking hammer with a round, slightly crowned hammer face and a blunt, bullet-like point is perhaps your best choice. Select a general-purpose "rail" or "universal" dolly ground to a number of radii. The spoon should have a nearly flat working face.

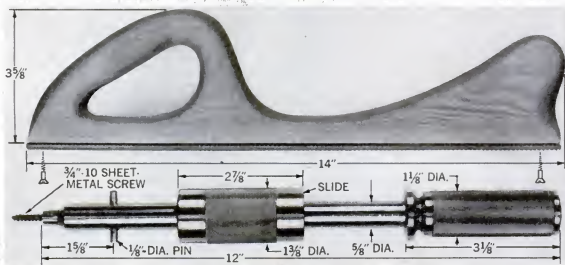
Body files are shear-rasps with coarse, semicircular teeth. You can buy a turn-buckle-type holder that will bend the file blade concave or convex.

**Doing the job.** With the right tools at hand, you're ready to go to work.

● **Dinging.** It's often possible to hammer out very small dents—rock-pocks, light creases, or shallow pop-outs—without damaging body paint. This is termed dinging.

A dent to be dinged should first be worked out to the level of surrounding sheet metal with light thumps struck on the back of the panel with the dolly. The area is then carefully planished with a hammer.

● **Bumping.** The heavier hammerwork needed to straighten a buckled dent or deep crease (bumping) ruins the paint and necessitates refinishing the panel. A typical bumping job involves first roughing out the depression, working the area smooth with hammer-dollywork, then filling.



**Make your own wood-handled body file (top).** Cut the handle from a short length of two-by-four. Saw the stock to 1 3/8" thickness, jigsaw to outline, then round off edges with a rasp and sandpaper. Attach a file blade to the handle with six or eight flathead screws, countersinking them in the file.

**A slide-hammer dent puller (lower photo) is another tool you can make.** It's an easy metal-lathe project. First turn the handle and shank; then turn the slide separately and bore it to slip-fit on the shank. Weld or braze a large sheet-metal screw on nose; pin shank to retain the slide.

# n Your Car

The trick in roughing out any creased dent is to unfold the creases without further stretching or upsetting the metal. This can be done with well-placed dolly blows struck from the back. Hitting with the dolly directly on a fold (it's a stiff, unyielding ridge on the back) will severely upset the metal. So the initial blows should be directed *between* creases close to the point of the impact that caused the damage. When the creases have been partially unfolded, lighter thumps can be struck wherever needed to drive the sheet metal out to contour. Next you straighten the panel by off-dolly hammering, working inward from the dent's edges.

- **Picking and shrinking.** Remaining shallow low spots are then picked—dimpled up from behind with the hammer's blunt point. Light on-dolly hammering flattens the dimples. Any slightly high areas can be worked down with hammer blows struck on the spoon to distribute their force.

- **Filling the lows.** Minor surface imperfections left in a hammered-out panel can be filled with 30-tin/70-lead body solder, or plastic-putty filler. For best results with either, the sheet metal first must be thoroughly cleaned.

*Continued*



Minimum kit of hand tools you'll need for do-it-yourself body and fender repairs includes, left to right: a blunt-pick body hammer, a universal dolly, a surfacing spoon, and a body file. For finishing and painting the repair, you'll need another and more comprehensive set of equipment.



**YOU CAN FIX THIS**

Pop-out dent is shallow dish-in in crowned body section—it pops back when forced from behind.



**...MAYBE EVEN THIS**

Buckled dent with valley-like creases must be unfolded before the panel can be straightened.

Collision damage destroys inner structural panels; a repair takes special body-shop equipment.

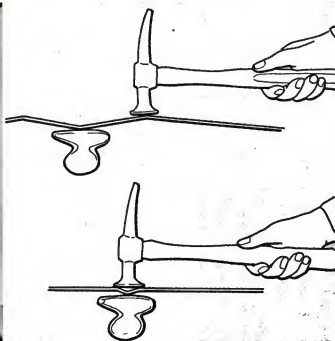


**THIS IS FOR PROS**

## Secrets of the trade: Know-how and understanding can be m



You can ding rock-pocks, spots, and small creases without ruining the paint if you polish the face of your hammer, until it's very, very smooth, and smear the damaged panel with heavy machine oil.



In off-dolly hammerwork, the dolly is used as rebound tool rather than as an anvil. The hammer knocks it away from the sheet metal; then it bounces back to pound the panel outwards.

Before tin-lead solder is applied, the sheet metal must also be acid-fluxed and tinned. The solder is then heated with a torch or in a mush-pot until it becomes a pasty semi-solid. With the tinned sheet metal heated simultaneously to the same temperature, the hot solder can be buttered on and shaped as needed with an oiled wood pad-

dle or paraffined canvas pad. When cool the fill is filed and disk-sanded flush, then finish-sanded by hand.

Plastic filler is simply spread on the cleaned sheet metal with a spatula. Epoxy base fillers stick better than polyester-based ones, and are thus more satisfactory on panels subject to vibration.

## Knowing how to use a tool comes only from experience, but an exper



Filing the panel you are straightening will leave file marks on high spots that need hammering down. Filing also causes low spots that need pounding out with the dolly to show to the eye as untouched areas. Use the file with light pressure so you avoid unnecessarily thinning the sheet metal.

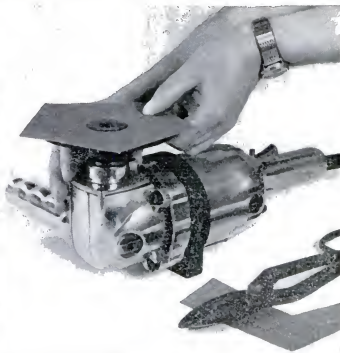


Disk-sand the hammered sheet metal to smooth out file scratches and bring low spots to view. Low spots can be dimpled up with the hammer's pick. Disk-sanding removes heat scale, old paint, and rust, preparing a surface for repainting. Any small pits or hammer marks should be scraped.

important than skill. There's always a right tool for the right job



When there's no access to the back of a panel, you can work out dents or creases and restore the contour with a slide-hammer dent puller. You screw it into holes that you drill in the sheet metal.



Five-sided sanding disk cut from 100-grit abrasive paper will feather-edge old paint around a repair. Use a dry disk on a power tool. To feather-edge by hand, wet-sand with paper on a rubber block.

● *Refinishing.* Before a repair is painted, the old paint around it should be feather-edged—wet-sanded to a 3"-wide taper—with 240-grit wet-or-dry paper. The area is then sprayed with primer-surfacer, from a gun or a spray can. Several prime coats will be needed to permit wet-sanding the surface really smooth with 320-grit paper.

If the existing paint isn't sun-faded, small repairs can be spot-refinished by mist-blending the final two coats onto the old paint. With larger repairs, it's simpler to sand down and respray the entire body panel. When repairs in several panels need refinishing, you might want the entire body repainted at a spray shop. **[E]**

vice can steer you away from many of the mistakes of the beginner



high metal surrounding the dent should be worked down gradually with hammer blows struck with the spoon as the dent is tightened. This job calls for use of a heavy hammer.



Small pits or hammer marks can be leaded in quickly with tin-lead body solder. Scrape the metal clean, tin with acid flux, then fill. Use a disk-sander to flush off the new base surface.



Plastic body filler costs less, is easier to use than tin-lead solder (no special tools are needed). It can be shaved down with a Surform rasp, used before the plastic filler cures completely.

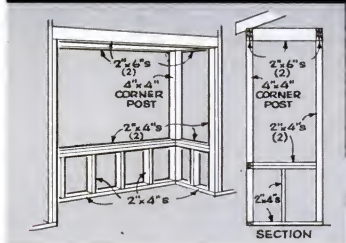
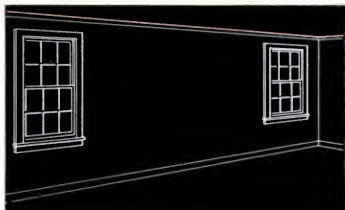
# IN YOUR HOME: Let There B

By **CARL T. SIGMAN**

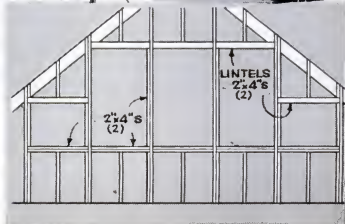
DRAWINGS BY SIGMAN-WARD INC.

**N**othing can beat natural light for the clean, bright, airy look it gives a home. But many homes, especially old ones, are dark even on sunny days. More windows, bigger windows, and better-placed windows will let in light and fresh air to revive these gloomy homes. And they'll give you a better view outside, too.

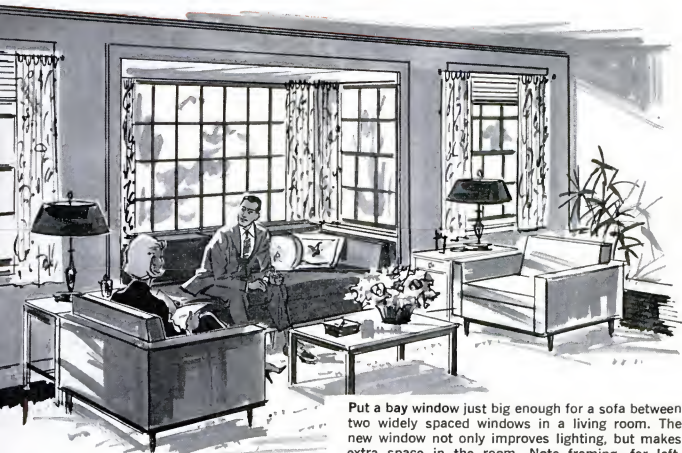
Here are nine ways to improve natural lighting in the living room, dining room, bedroom, attic room, hallway, even the bathroom. You can develop the ideas yourself, or with the help of a carpenter. Any of these alterations will increase the value of your home, so you can get loans to help finance the projects if you wish. One thing to remember: Before you start a project, check your local authorities to see whether or not you will need a building permit.



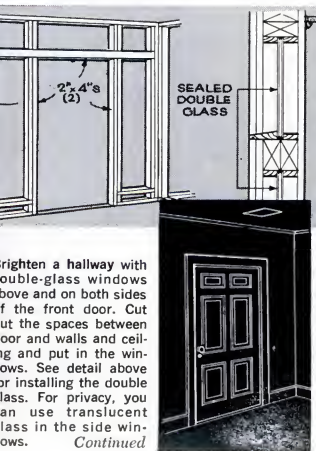
Add sealed double-glass windows on either side of a gable window. Low windows light desks. You'll have to remove some studs to make room for the new windows, so reinforce the others with two-by-fours.



# NATURAL Light



Put a bay window just big enough for a sofa between two widely spaced windows in a living room. The new window not only improves lighting, but makes extra space in the room. Note framing, far left.

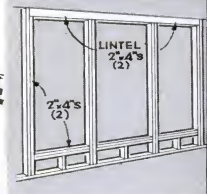


More and larger windows throughout the house will



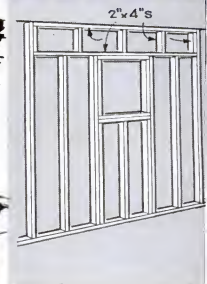
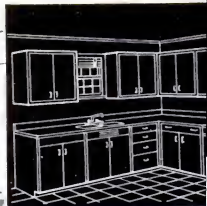
A window wall in the dining room replaces small single window, lets in more light and gives you a wide view. The center window is fixed; the end win-

dows are double-hung for ventilation. You'll need double two-by-six lintels and some two-by-four framing. Install screens over the side windows.

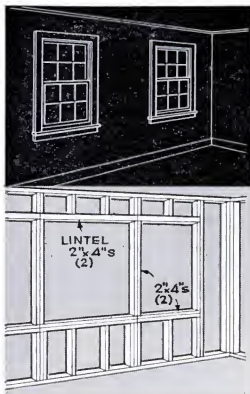


Build swing-in windows, hinged at bottom, into the wall above kitchen cabinets. They'll spread natural light over the entire room, and let out hot air and

smoke from cooking. Kitchen windows get dirty quickly so you might want to use translucent or tinted glass to hide dirt and save frequent washin-



shine and cheer to your rooms throughout the year



Cut out the space between two windows and install a double-glass picture window. Put a desk in front of the window for a bright place to study or write.



Add light curtains to cut the glare of the midday sun and for privacy at night. Check the framing diagram at left for details of construction.



Two sliding windows help ventilate and light a bath. Cut out the studs beside the usual bathroom window and install the sliding panes flush with the top of

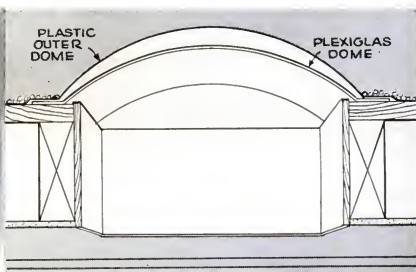


the old window. The higher you make the windows, the better they'll ventilate, the more privacy you'll get. You can use translucent glass. *Continued*

## How to bring natural light to a fireplace area or hallway



Replace high stained-glass windows in an old home with sill-to-ceiling picture windows. They'll give you more light than the old dark windows, and give the whole room a bright new look. Use sealed double-glass units to minimize heat loss in the winter and to keep the room cool during summer. See framing diagram for details.



A skylight is the only way to let natural light into a hallway or room without outside walls. Double plastic domes are installed between rafters, and are completely waterproof. They are translucent, so they throw an even blanket of diffused light over any room you use them in. They are especially good for bathrooms and kitchens, and are best installed on flat or very-low-pitch roofs. **PS**





## Shop Talk

By ROBERT P. STEVENSON

### Need quick heat occasionally for shop work? Try "canned heat"

Does it pay to have a source of quick heat on hand in a home shop? If so, would Sterno be a good bet? Would *you* use it? For what jobs? To get answers to these questions, we asked the manufacturer to send a sample container of "canned heat" and a single-burner folding stove (an outfit that sells for about \$1.50) to a dozen men who regularly write workshop articles for *POPULAR SCIENCE*. We asked each one to keep the can and stove handy and see what uses came to mind.

A couple of instant-coffee devotees got no further than heating their water. We expected this. Another man, the joker in the crowd, carried the outfit on a canoe trip and cooked a romantic Sunday morning breakfast of ham and eggs for his wife in the middle of an isolated lake. But others, more serious, found it a handy bench-top heat unit.

Putting a spindle in a Windsor chair, Jackson Hand left the end of the spindle slightly oversize, then warmed and dried it in the heat until it went into the hole. When the wood regained its natural moisture content, the joint was nicely snug. Phil McCafferty, who often works with metals, reported the Sterno stove excellent for heating bearings and parts for shrink fits; for heating small steel items for tempering and heat-treating; and for melting solder for dip soldering.

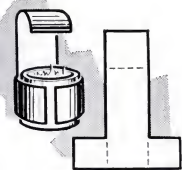
Phil also took the time to shape a sheet-metal heat reflector as shown in the sketch and found that he could get concentrated heat a fair distance from the flame. This proved handy for speeding up the curing time for epoxy and for baking enamel on small parts. He also dug some of the jellylike material out of the can, daubed it over a frozen nut, and ignited the stuff. The nut was then easy to turn.

Building a canoe, George Daniels placed the heater under the inverted craft and discovered that the resorcinol resin glue he was using hardened in less than half the time required at normal room temperature. A thermometer inside the inverted hull showed a temperature of 100 degrees. Both Daniels and Hand used the flame to heat a spatula for applying stick shellac in furniture repairs. Howard C. McEntee suggested warming glue and varnish (in a water bath) for more effective use. Jack Hand heated a putty knife and used the hot knife to soften paint for easier removal from a small antique he was refinishing.

While making the survey, I learned a fact that you may like to know, too—that Sterno outfits are very popular with troops in Vietnam for heating rations while on patrol. But they're not always available through the PX. So maybe that's your cue! The folding single-burner stove weighs less than a pound; the large can of fuel, only seven ounces. That leaves space for other goodies, too, in the package weighing not more than five pounds that the APO will jet overseas quickly.

### Rocking chair is winner in Stanley woodworking contest

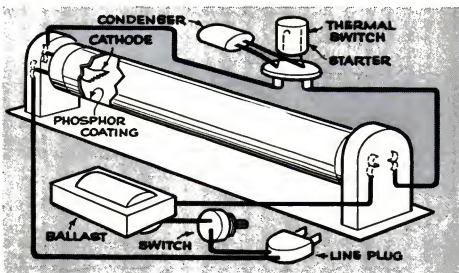
The rocking chair at left was the grand prize winner in a woodworking contest that Stanley Tools recently conducted among high-school students. It brought a \$1,000 award to Steven Kammeyer of Denison, Iowa, whose instructor was H. A. Jacobs. You can buy plans for the chair and nine other award-winning projects by mailing a dollar to Stanley Tools, Box 1800, New Britain, Conn., and asking for the Stanley woodworking project plans, series SS 1.



# How to Troubleshoot



Starters do go bad and cause troubles such as flickering, and slow or no starting. Best rule: Replace starter with every second tube change. Inside view shows condenser and glass-enclosed thermal switch.



**How fluorescent lamps work:** Light is produced when energy from a mercury arc activates fluorescent powders lining inside of tube. (These powders are nonpoisonous in tubes made since 1949.) A ballast transformer limits current through lamp and controls starting and operating voltages. The starter controls heating time of cathode, breaks ballast circuit to provide starting kick, cuts TV and radio interference.

**F**luorescent lamps can be puzzlers. Besides dying an uncomplicated natural death, they suffer from various ills. Some of the problems may be due to the controls required for their operation, but making sure the tube itself is the first step you should take.

**Check the tube.** Turn gently in the socket to make sure the connection is good. Replace it with a lamp that you know is good if it fails to come on.

**Check the starter.** Replace it with one that you know is good, but make sure it's the proper size. Lamp manufacturers suggest putting in a new starter with every second bulb replacement.

**Check the fixture.** Be sure the wiring from the lamp holders and starter socket is correct and tight. Watch for shorts, open circuits, and grounds.

**Check the ballast.** If the above tests do not remedy the trouble, try another ballast you know is good.

There are peculiarities to watch for with fluorescent lamps. They are fussy about the



## Simple hinge lock for saw-blade guard

It is sometimes desirable to lock the blade guard of your portable power saw in an elevated position. Otherwise it will catch when you cut thin strips, like those from the bottom of a door. Some saws come equipped with a lock; others do not. A flip-lock with a small hinge, one flap of which is epoxied to the saw frame as indicated (left) by the pencil, does the job efficiently. Flipped back for normal operations, the flip-lock is out of the way; flipped forward, it catches and holds the blade guard in the position shown in this photo.

W. G. WAGGONER, Sacramento, Calif.








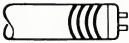
# Fluorescent Lamps

ature. They put out the  
atest amount of light be-  
een 70 and 80 degrees.  
low that, light output falls  
badly. Cool breezes blow-  
g around the fixture may  
use erratic operation of the  
be.

Obvious differences when a  
up is changed in a two-  
up fixture may be due to  
e fact that fluorescents are  
de to be extra bright dur-  
the first 100 hours of life.  
ree shades of white on the  
arket may account for a  
mparative color difference.  
p. Changing both paired  
bes at once may be a good  
ea.

When buying a replace-  
ment tube, check the etching.  
some sizes, you can choose  
m three types of lamps: In-  
stant Start, Preheat Rapid  
Start, and Preheat. When  
making replacements, use a  
e tube whenever possible.  
hile Preheat Rapid Start  
bes will work satisfactorily  
most fixtures designed for  
eheat tubes, Instant Start  
bes will burn out the ballast  
fail to light in circuits de-  
signed for different tube  
bes.—Phil McCafferty.

## FLUORESCENT-LAMP CHECK LIST

	1. Starter near end of life. 2. Wrong ballast. 3. New lamp may flicker, should improve as lamp ages.
<b>SWIRL OR FLICKER</b>	
	1. Low temperature; cold draft hitting lamp. 2. Defective tube. 3. Defective starter. 4. Loose contact. 5. Voltage low.*
<b>BLINKING OF NEARLY NEW LAMP</b>	
	1. May be normal transformer hum. 2. Overheated ballast. 3. May require special low-noise ballast. 4. Ballast transformer loose.
<b>NOISE</b>	
	1. If ends of lamp remain lighted, short-circuited condenser or starter-switch contacts welded together. 2. If prolonged flashing or off-on blink at each start, defective starter. 3. Voltage too high.*
<b>EARLY BLACKENING</b>	
	1. Too many lamp starts per burning hour. 2. Below-average tube. 3. Too-high or too-low line voltage.* 4. Defective starter.
<b>SHORT LAMP LIFE</b>	
	Grayish feathers are mercury usually seen on lower or cooler parts of bulb. Try rotating lamp to evaporate.
<b>DARK STREAKS ALONG TUBE</b>	
	1. Sometimes signals near end of tube life. 2. Occurring early indicates excessive current.* 3. May be bad tube.
<b>DENSE BLACK SPOT NEAR END</b>	
	Fairly common condition that may occur about 2" from one or both ends. Does not affect lamp operation.
<b>GRAY RINGS</b>	

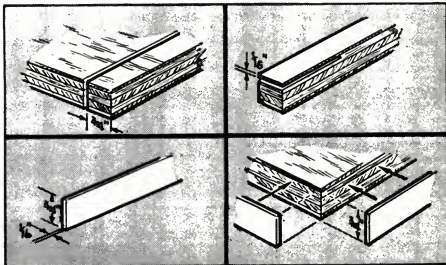
Illustrations courtesy Champion Lamp Works.

\*Ballast at fault

## A simple edge cover for finishing plywood jobs

Unightly edges that mar your plywood projects can be hidden easily. Cut a strip of the plywood as wide as the thickness of the edge that needs concealing (1). With a circular saw, slice off the surface veneer  $\frac{1}{16}$ " thick or less (2). Then glue on this thin strip (3) and for a perfect match apply the same finish (4) used on the top.

L. MATTEUCI, Philadelphia.





Materials as unlike as metal and brick (above) stick together when simply pressed in place by hand.

Mounting ceramic bathroom fixtures, a job normally needing skill, is easy with Touch-n-Glue.

## New Glue Needs No Clamps

You can glue together almost anything—wood, metals, ceramics, plaster, concrete, leather, fabrics—with Touch-n-Glue, U. S. Plywood's new water-resistant mastic adhesive. And it's so sticky it makes clamping pressure unnecessary except on heavy parts positioned on a vertical surface.

It works like contact cement. You put glue on one surface only, press the two surfaces together, then pull them apart and

let the glue dry for five to eight minutes. When pressed back into position the parts are held in place by built-in tackiness. A permanent bond forms in about 24 hours.

Unlike contact cement, the new glue does not cling so tightly at first that you can't position the work. Also, its solvent is non-flammable.

Touch-n-Glue is sold in collapsible metal tubes: 1½ ounces for 98 cents, five for \$1.59.



Adhesive comes in collapsible metal tubes. It is heavy-textured, won't drip or run, spreads easily.



Loose floor tiles stay put with a few dabs of this adhesive. It forms a strong, yet resilient, bond.



**BEST FINISHES FOR WOOD:**

# **Now Everyone Can Use Lacquers**

**High-quality finishes come in spray cans for small jobs—and the stuff is easier to brush nowadays, too**

**By JACKSON HAND**

**M**ention lacquer to the average home-based wood finisher and he'll tell you, "Forget it. Too hard to use. Besides, they say it's a fire hazard. I'm better off with varnish and enamel."

Since this attitude is widespread—although not really justified—many finish manufacturers go out of their way to keep the word "lacquer" off their labels. As a result, you have probably used more lacquer than you realize—and used it successfully.

For instance, Krylon is labeled "spray enamel," but technically it's lacquer. Fabulon, labeled "floor finish," is a lacquer. Rez-20 doesn't tell you it's a brushing lacquer, but you might get a hint—and a chuckle—from the rec-

*Continued*

Lacquer by any other name is still lacquer. Here are helpful h



Lacquers that you can buy at your local stores are shown here—clear and colored spray cans, an excellent high-build floor lacquer, one of the new acrylic lacquers, and a standard brushing lacquer.



Here's a good trick for spraying all sides of a project. Turn three screws into the bottom of the object to stand on. Spray the bottom, turn over, spray the rest. Finally, fill holes, spray bottom again.

ommendation that you clean Rez-20 brushes in lacquer thinner. On the other hand, Satinlac labels itself openly as "lacquer." Some of the Bromo spray-can line by Derusto is lacquer—and is so labeled.

So—lacquers are too hard to use? Not any more. With brushability under control, any of us can lay on a smooth coat of lacquer. Low solids content is being licked, so it takes fewer coats to build a good film. On-the-wood quality of spray-can lacquers improves every day. In many respects, clear or colored lacquers are easier to use than any other material.

Flammable? Yes, but common-sense adherence to the warnings on labels just about eliminates fire hazard. And new formulas have much higher flash points and need only the "combustible mixture" warning required by law on ordinary paint.

**What is lacquer?** That's a good question because lacquers today are in a state of change. Traditionally, lacquers have been based on nitrocellulose. Since this material must carry, by law, extremely cautionary labeling, manufacturers are eager to come up with lacquer's advantages in a product that doesn't have to be labeled FLAMMABLE in big, black letters. As a result, there are switches to acrylic, to vinyl, and to other film-forming resins and formulas not requiring labels that will scare customers away. Chances are, many paint chemists feel, that nitrocellulose will someday be entirely replaced by other resins not such close cousins of guncotton.

So what is lacquer? Paint technologists use this definition:

"Lacquer is any material that hardens entirely by the evaporation of its solvents and does not depend on oxidization or curing for toughness of the film."

This lets in many modern resins, but eliminates those that dry, then harden gradually over a period of time.

What, then, is enamel, and how can they label a can enamel if it is lacquer? No sweat. Enamel is "any colored film," the paint chemists say, regardless of its kinship to the lacquer family or the varnish family. It doesn't even have to be glossy in today's terms; you can buy a paint labeled "enamel" that dries dead flat.

It is just this "dry-when-it's-dry" characteristic that makes lacquer the quickest finish of all. When the quickness is tempered somewhat, as it can be by the use of certain slow-drying solvents, lacquer is about as easy to use as varnish.

**How lacquers differ in use.** The easiest way to familiarize yourself with lacquer is to compare its working characteristics with those of varnish and enamel, which most of us can handle.

- **Wood darkening.** Lacquer darkens—"wets"—the wood least of all clear finishing materials. It is water-white, nonyellowing in quality grades. Some brands and varieties (for instance, Fabulon's companion, Pryme) darken only about half as much as varnish.

- **Drying.** Lacquers normally dry to the

recognizing it, and using it in either spray or brush-on form



Rubbing with 400 waterproof paper is final step in producing fine colored finish, after three or more coats out of a spray can (as at left). For small projects, this will give a Chinese-lacquer quality.

More and more brushing lacquers are coming on the market, joining such favorites as Fabulon which, although intended for floors, is good for all wood finishing, including guitars, as shown here.

touch in about 30 minutes. They are completely dry in about three hours, ready for use or for recoat. *Important:* Some modern formulations are "dry" in about the same length of time, but lack "dry-through." In other words, if you sprayed a chair, it might seem dry, but if you sat down on it . . .

(Most experienced finishers allow more than three hours for recoat, to avoid the cross-grain checking that often occurs when coats succeed each other too quickly. Nevertheless, it is always possible to put two or three coats of lacquer on a project in one day, unless drying conditions are bad.)

● *Build.* All lacquers except those intended for industrial spraying are lower in solids than varnish or enamel. In typical workshop practice, you need three sprayings of good spray-can lacquer to equal the build of a varnish or enamel. However, the three coats dry in less time than the varnish or enamel and may be smoother since you can sand smooth between coats.

The low solids content of lacquer is being built up in some modern formulas by the addition of alkyd resins. This is true, for instance, of Rez-20. It may jar a purist's sensibilities to see both nitrocellulose and alkyd resin in the formulas on the labels—but these are the times that jar a finishing expert's sensibilities.

**Intercoat sanding.** Each coat of lacquer "welds" to the previous coat. The solvents actually soften the dried coat minutely—no matter how long it has been on—and the two coats become one, with no ad-

hesion line. For this reason, you do not have to scuff-sand between coats in order to insure the best adhesion, as with varnish and enamel. The only sanding necessary is to smooth away dust blemishes and level the surface. In practice, you can often apply several coats to achieve the required film thickness, then rub the final coat only.

● *Leveling.* Brushing lacquers do not level as well as varnish or enamel. Unless you flow them on full and smooth, with a fine-quality brush, there is a good chance that they will take an initial set before all the brush marks have leveled out. At the same time, if you don't move fast enough, lap marks will show.

● *Thinning.* You almost always thin lacquers, either for brushing or spraying in regular equipment. This helps overcome the over-quick hardening, unless you use cheap thinners which may evaporate so quickly the problem is accentuated.

[\[Continued on page 196\]](#)

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**"Best Finishes for Wood" Now a Book**

During the past year, we have presented to POPULAR SCIENCE readers this series of authoritative articles on wood finishing. Highlights were antiquing, wood staining, and applying finishes to pine and fir plywood, illustrated in full color. We conclude with this installment on lacquers. The entire series has now been published as a paperback book, *How to Do Your Own Wood Finishing*, by the Popular Science Book Department.

# The Case for Buying a Reel

Manufacturers are bringing them back this year in new styles. The high-wheelers are making news, too

By JACKSON HAND

**M**en buying lawn mowers this spring are making two discoveries worth a strong round of applause:

First, it gets harder and harder to find one of those skimpy assemblies of wheels-housing-handle-blade-engine that flooded the market on the heels of the great migration to suburbia. Manufacturers are giving you more good engineering and more useful, nongimmick operating features.

Second, manufacturers have rediscovered the reel-type lawn mower. They are improving it, and they are shouting its advantages to a generation of householders who have all but forgotten what a beautiful job of mowing you can do with a reel, compared with a rotary.

The return of the reel is the most significant of these two trends. It represents a sort of coming of age in lawn care. A spokesman for Jacobsen explains his company's renewed activity in reels this way:

"A man buys a rotary mower—maybe two. Using them, he develops an interest in better lawns and in better equipment. The next mower he buys is a reel. He's ready for quality."

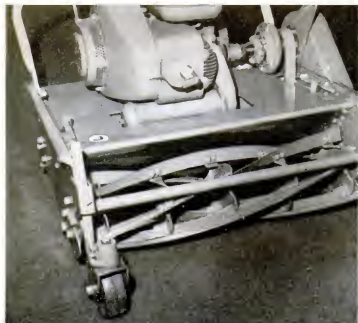
At Sears, a lawn expert said: "We have had engineers working to improve the reel to satisfy more customers who realize that the difference between a patch of grass and a real lawn is a reel mower."

The overriding advantage in reels, of course, is safety. Nothing on a reel mower spins fast enough to create the sort of hazard represented by a rotary blade. The cutting action is deep beneath the mower, where insertion of finger or toes is rare and unlikely.

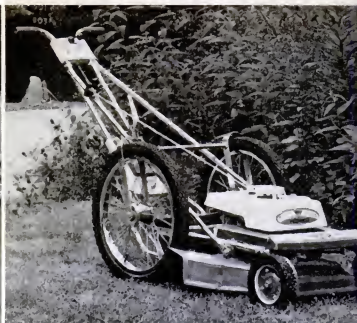
**What you get in a reel.** Advantages of the reel mower have almost all been with us for years, but no one has bothered to mention them lately:

- A better, smoother cut and finer clippings that bag better, or sift into the stubble if you're a nonbagger.
- Tougher, more rugged construction.

*Continued*



New design for reels is illustrated by this Jacobsen. Driver wheels behind and casters in front are set in so the reel ends can cut close to obstructions.



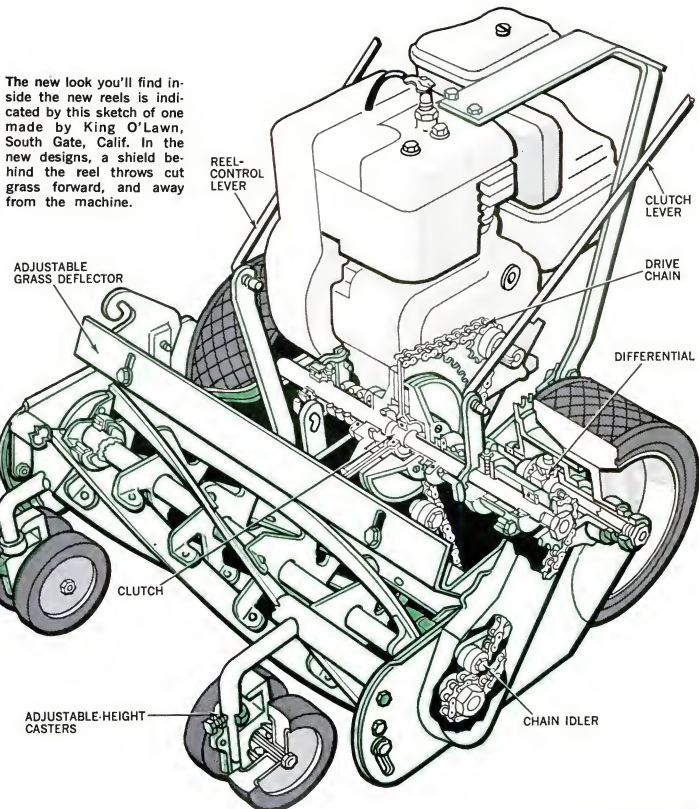
High-wheelers are increasing in popularity as lawn-care machines because they're long-lived and easy to use. This Homko machine is typical of the breed.

# Mower

Yardman's rider has a suspended reel that floats over the grass ahead of mower. All wheels are kept in, and it's easy to mow up close to trees and fences on the lawn. Yardman also has a front-hung rotary mower.



The new look you'll find inside the new reels is indicated by this sketch of one made by King O'Lawn, South Gate, Calif. In the new designs, a shield behind the reel throws cut grass forward, and away from the machine.





Even in hand-push reels, you now find new ideas cropping up. For example, the Sunbeam above has an easy height adjustment—once a screwdriver-and-wrench job.

New ideas also are found in conventional powered reel mowers: such features as fold-down handle, deadman control, and plastic grass catcher as on this Jacobsen.

- Longer life, mainly because reel-mower motors run at a fairly relaxed speed, instead of just about wide open all the time.

- Excellent maneuverability.

- A sort of freedom from sharpening. Reel blades are usually fine steel. The cutting action is a shear. On some wider models, the cutter bar is supported centrally as well as at the ends, to prevent bowing and consequent uneven wear.

- All powered reel mowers are self-propelled.

To these, add the following fairly recent improvements:

- A fold-down or stand-up handle to facilitate storage.

- A deadman control on several makes. Typical are a handle that requires a slight forward pressure (though no actual shoving) to produce a forward motion, as on Jacobsen models; a handle that must be held up to about waist level for forward drive, and shuts off the drive if it is lowered, as on Homko models.

- Simple height controls that work with knobs, dials, or pins, taking adjustment out of the wrench-and-screwdriver category.

- Frames of box design that house blade

**Some of the good mechanical features you'll find in this year's rotary mowers**

In Toro you should note oil reservoir that makes it easy to maintain proper oil level, and steel finger that picks up straggling growth at edges and brings it to blade.



Collapsible handle on many models of rotaries now makes them easy to store, even under a table workbench. Below is an MTD machine compacted for storage.



and gears and provide nontwist strength to keep reel and cutter bar in line.

- Advanced methods of gearing that set the reel out from between the wheels. This facilitates safety shrouding of all moving parts and makes bagging more efficient. MTD Products is an example.

- Front throw that keeps the clippings out of your pants cuffs. This, coupled with narrow-track wheels behind and casters mounted inboard in front, lets you mow close to the wall. King O'Lawn and Jacobsen do this very well.

- Spring-loaded reels (as in Pennsylvania) that give if you hit a stick or stone that gets between the reel and the cutter bar, reducing the danger of damage to the mower.

**The high-wheeled rotaries.** Another big trend in mowers this spring is a northward migration of the high-wheel model. A few years ago, this machine was little seen north of Mississippi. Now a great many manufacturers have brought out high-wheelers (MTD, Jacobsen, Hahn-Eclipse, Homko, Roof, and more).

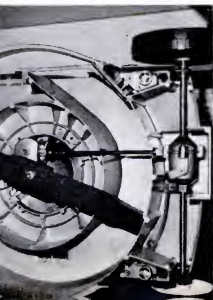
The main use for high-wheelers has been in tall grass or weeds, and particularly for the best hot-country grass varieties, which seem to do best if they are allowed to grow fairly high. These mowers have excellent characteristics for any lawn:

- Smooth, easy rolling because of the high wheels. So easy are high-wheelers to push, that many, even in big sizes, are not self-propelled.

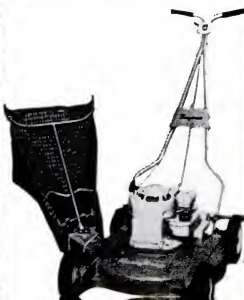
- Good handling, owing to the balance of the business end in front of the axle and the engine over it and slightly behind.

- Close cutting along walls and around

drive idea from Sunbeam is gear throughout. A pair of bevel gears picks power off the spindle and transmits it via a shaft to a differential-type axle.



Bags are getting bigger, but easier to handle. This is Pennsylvania's high-capacity version, with a T support to hold the bag open so that every corner fills.



Slick suspension idea by Homko has wheels mounted on a U-shaped steel-tube frame. Working parts hang on frame and are easy to raise and lower by a crank.



Easy starting is shown in Tecumseh display engine. Geared pulley, driven by rope, meshes with flywheel, gives advantage to overcome compression.

trees, despite the size of the machine, since the wheels are inboard on most makes.

- Rugged construction and long life. The blade is belt- (or similarly) driven, and motor speed can thus be kept down.

- Cutting width up to 24 inches or more.

The high-wheelers are heavy-duty machines, and they cost it. But buy one and you'll hand it down to your children.

**What's up with rotaries?** The news in rotaries lies less in innovations than in the spreading of good ideas to improve ease of handling and to make maintenance simpler. An example is the increase of lightweight die-cast housings and bigger wheels. The machine weighs less and rolls easier and more smoothly. You'll no doubt see more and more magnesium, following the lead of Lawn Boy, Toro, Sears, and some others.

There are gains in blade design—more and more of them hinged near the ends to reduce impact, more and more multi-cutter disks, domes, etc. The industry is constantly at work on blades, and spokesmen say that improvements come almost daily. The result is better grass cutting, better clipping discharge, and more safety.

*Continued*

**Slowing down the engines.** Aside from such features as washout ports for hosing the housing clean underneath, most maintenance gains have been in engines. A basic change, often unnoticed and rarely mentioned, is slower engine speeds. A mower manufacturer orders engines from Briggs & Stratton, Tecumseh, or others with the speed adjusted for 3,000 r.p.m.—even as slow as 2,800—instead of the 3,600 or so it used to be. This reduces engine wear tremendously and at the same time brings the blade-tip speed within the 2,000 or so feet per minute the safety experts like best.

To a man, manufacturers state flatly that high engine speeds are not necessary to cut grass, that slower speeds would put years on a mower's life. Some mowers have a selection of at least two speeds, sometimes more. Manufacturers put detents in the accelerator to encourage the user to run the engine at that speed. But—almost to a man, mower owners crank the engine up to its highest speed and run it that way for hours. These are the same men who would gasp at the idea of running their car engines wide open.

Stimulated by their successful assault on mowing hazards, the industry has been conducting more lab testing and quality control, seeking to put longer life in a rotary. A minimum these days is 200 hours of hard use for a rotary—equivalent to about four or five years on an average lawn.

**Engine features.** New or spreading engine features include the following:

- The auto-oiler idea, introduced by Toro, which makes oil level so easy to maintain that nobody would let the crankcase get low.

- Fixed jets, which are an advantage mainly in that wrench-happy owners can't monkey them out of tune. The fixed jet is best on hand-propelled mowers, since individual adjustment may be necessary on self-propelled models to accommodate to conditions.

- Easy start—considered by many experts to be more of a safety feature than a convenience. Basically, easy starting is accomplished by gear-down in the link between pull rope and flywheel, *plus* a hotter spark, *plus* a slightly advanced spark—all of which help make the engine start when you crank it at about 20 r.p.m. instead of the 30 or more r.p.m. of old. Add to this pushbutton priming.

Another easy-start device has the cam hold open the exhaust valve a tiny bit, reducing the amount of jerk it takes to pull past compression. In some engines this slight compression loss is inconsequential at normal operating speeds; in others the valve is held open by a retractable pin in the camshaft that protrudes and holds the valve open when you pull the rope but sinks flush when rope tension eases and lets the valve close normally.

One of the slickest ideas continues to be the no-carburetor, venturi system of fuel injection brought out by Sears a year ago [PS, Sept. 1965].



## NEXT MONTH: Riding Mower or Tractor? Which for You?

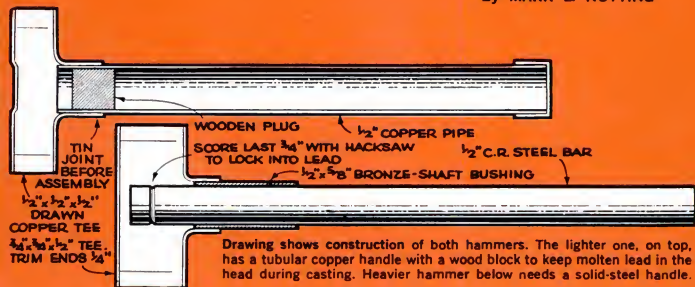
You'll find the answers to these questions in an April article. Also look for a summary of the lawn-mowing products of all major U.S. manufacturers.



Lead hammers pack more punch for their size than other soft hammers. They are hard to find in stores, but you can make your own like the two above using drawn-copper water-pipe tees for the body of the heads.

# Two Soft Hammers You Can Make

By MARK L. NUTTING



Drawing shows construction of both hammers. The lighter one, on top, has a tubular copper handle with a wood block to keep molten lead in the head during casting. Heavier hammer below needs a solid-steel handle.

Wooden mold contains the hot lead and holds the tee. Drill two  $\frac{3}{4}$ " blocks to the O.D. of the tee. Nail one to a plain block with an aluminum-foil heat sink between. Fit tee in hole, add top block.

Here's the completed mold, ready for casting. The ends of the tees should be about  $\frac{1}{4}$ " below the surface of the blocks. Slightly overfill the mold with very hot lead and let cool for 10 minutes.



# 5 New Woodworking



Slide that holds disks is tilted to feed them one at a time to the players. Braced table legs fold in for compact storage and easy transportation.



Compartment 4 has lid, double as a storage bin for disks. Scoring through narrow slits requires a little skill and a lot of luck. Each player shoots all 32 disks.

## 1. A GAME BOARD FOR FAMILY FUN

The rules of Skill-O-Disk are easy enough for the kids to understand, and yet the game is challenging enough for grown-ups. It's especially good for parties because while one player is shooting, the others can either watch or come and go as they please until it's their turn.

The table takes up little room when in use, and it folds quickly for compact stor-

age. The photos and diagram give all necessary construction details. A table saw makes the job easier, but you can get by with hand tools.

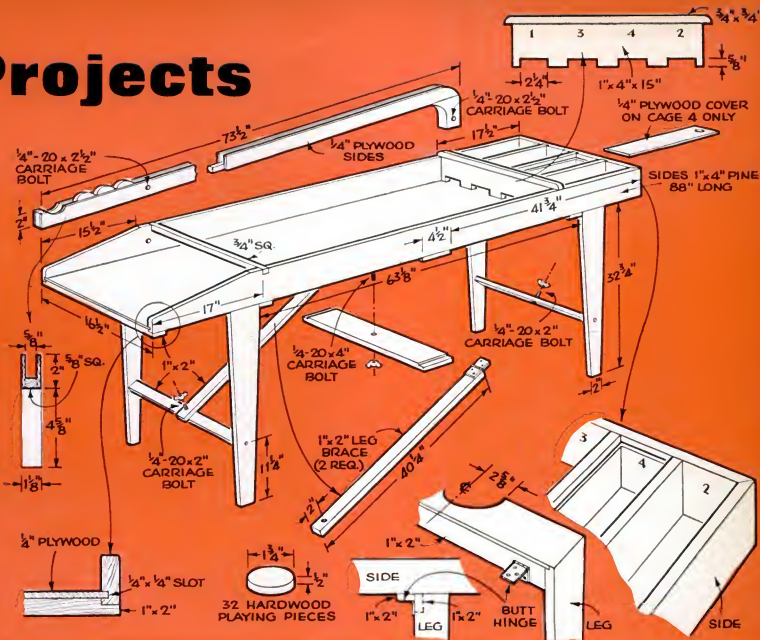
To play, you slide disks down the 16½"-by-88" table, which is made of plywood and pine. Scoring is straightforward: If you get one disk in bin 4, you have four points. If you get the next disk in bin 1,



## 2. A BETTER CUTTING BOARD

Slippery, squirmy vegetables and meats are easier to slice when they're trapped within the walls of this cutting board. Make the basic board from 1"-by-1½" strips of hardwood glued together; waterproof re-

# Projects



your total is five points. A disk in every bin adds up to 10 points but, as a bonus, your total is doubled. Before starting the game, determine what score wins. With a small group of players you may also decide to play a set number of rounds to bring the game to an end.

The disks (you need 32 of them) are formed by turning or planing a 30" piece of two-by-two hardwood until it is round and then sawing off slices. Absolute roundness

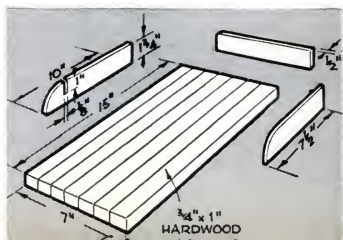
isn't essential, but sand the disks on top and bottom so they slide easily. Cut a few spares for loss or breakage.

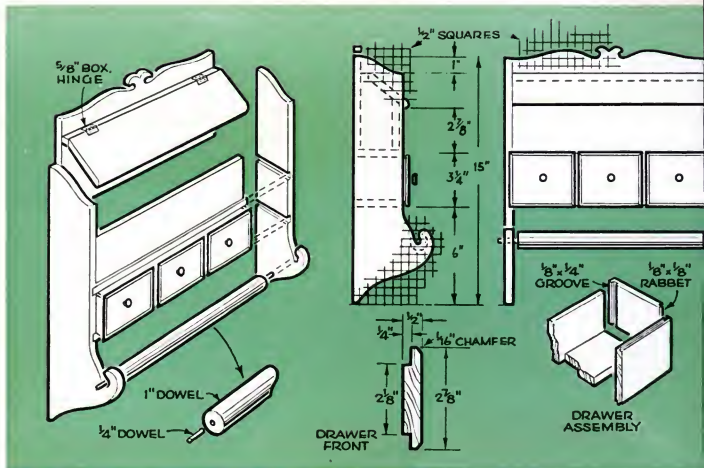
The 3/4"-by-3/4" bar across the top toward the players' end is a foul bar; it keeps the players' hands back when they are shooting. A cover over bin 4 provides handy storage for the disks.

Don't paint the playing surface. Sand it smooth, varnish it, rub it down with fine steel wool, and wax it.

sorcinol glue is best. Cut the two sides to two-thirds and one-half the length of the board. Then, in the longest side, cut a slot wide enough for a large knife-blade tip. Make sure that the knife will clear the opposite side. Finish the board with a penetrating sealer or several applications of hot salad oil.

*Continued*





## 4. MOBILE PLANTER FOR HEAVY HOUSEPLANTS

Four casters hidden beneath this redwood planter let you roll even the heaviest houseplant to a sunny window during the day and back to a better display area in the evening. And if you spill while watering, clean-up is easy: Just roll the plant out of the way and mop up.

To start construction, cut out the four 3/4" redwood sides, miter the ends, and make a 3/8" groove in each side to hold the bottom of the planter. Locate the groove so the top edge of a large clay saucer placed in the planter is flush with the top of the planter. Another groove, this one 1/8", holds the corner gussets to which the casters are screwed. Locate this groove so the casters hold the planter 1/8" off the floor (or perhaps 3/4" or more if the planter is to be used mostly on a carpet).

Now cut the gussets from 3/8" plywood and the bottom from 3/4" plywood. The bottom is a square with corners cut off to clear the casters. Assemble the sides, gluing the bottom into the 3/8" groove. Glue the gussets into the top groove. Then cut the separators to size and glue and screw them between the gussets and bottom.

Screw the casters to the gussets and finish the job with varnish.

Put the saucer in the planter and fill all around with crushed rock. Now it's ready for the potted plant. Dimensions, which are for a 13" saucer, can be changed to suit your needs.



## 3. KITCHEN-TOWEL HOLDER

Those new bordered paper towels are just the thing for this Early American towel holder-cabinet made from  $\frac{1}{2}$ "-cherry.

First lay out and cut the sides. Dado the grooves for the dividers, and then cut the dividers and glue them in place. Next cut the back and front trim pieces and glue them in position.

Saw out the front and back sections of the drawer, rabbet the back, and dado a  $\frac{1}{4}$ " groove to receive the sides. Divide the front into three equal parts and dado  $\frac{1}{4}$ "-deep grooves along each line. Tilt the blade on a radial-arm saw to 45 degrees to cut the chamfers. Cut the remainder of the drawer parts, dado the sides, and assemble with glue and brads.

Cut the hinged lid for the chest top and the spacer strip to which the hinges will attach. Glue this strip in place. Bevel and round the lid and set it aside.

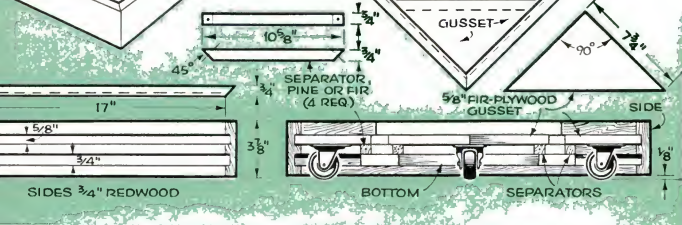
To form the spindle, drill a  $\frac{1}{4}$ " hole at each end of a 1" dowel and insert and

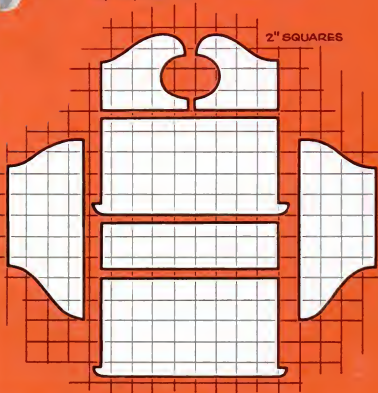
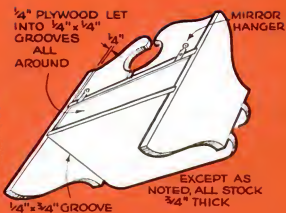


glue  $\frac{1}{4}$ " dowels in these holes so that they protrude 1".

Sand the entire project with fine sandpaper and stain with antique cherry, following up with a semigloss varnish. Finally attach the lid with the hinges and mount the brass knobs.

*Continued*





## 5. BESIDE-THE-PHONE SHELF

An ideal project for a beginner, this telephone shelf has a built-in allowance for error—a two-piece ornamental backrail that insures a good fit at the sides without a precise cut. The space between these pieces also neatly disposes of a dangling cord from a radio or electric clock.

Shape the two back-rail pieces and nail them to the top shelf from the underside, reinforcing the joint with a little glue. Next shape the two sides, making dado cuts for both shelves. Attach the sides to the top-shelf-and-back-rail assembly with more nails and glue, using furniture clamps to hold the work in place. Toenail from the underside of the shelf and from behind the back-rail sections; you can countersink these nails and forget them since they won't show.

Now add the back, made of  $\frac{1}{4}$ " plywood, and the bottom shelf. With the bottom shelf in its groove but a few inches forward of its final position, force the plywood back into the grooves provided for it in the top and bottom shelves. As you push the bottom shelf into place, the plywood, too, will move into position. Secure by nailing from the underside of the bottom shelf and conceal the nails with wood putty. Mount two mirror hangers on the back edge of the top shelf and the construction is completed.

If you sanded the pieces to a polish before assembly, stain-wax will give you a handsome finish on any wood. White-pine scraps were used to make the original project.

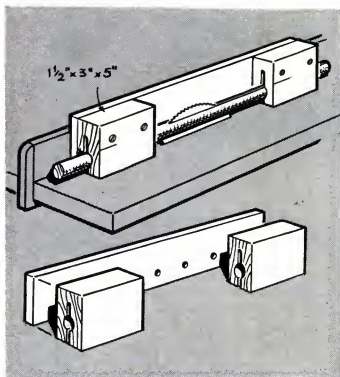
## SHORT CUTS AND TIPS

FROM PS READERS

### How to make a simple guard for your chain saw

A chain saw is very easily dulled unless the cutting teeth are protected when not in use. A guard is easy to make. Cut two pieces of perforated hard-board slightly larger than the profile of the saw. Separate these with strips of  $\frac{3}{4}$ " wood to make a pocket. Keep the guard in place on the saw with a heavy rubber band.

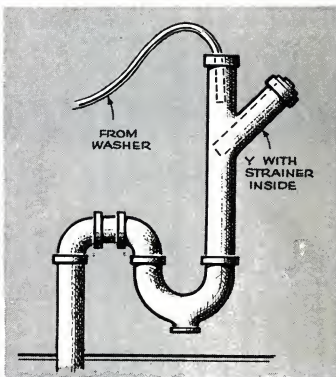
WAYNE M. JUDY  
International Falls, Minn.



### Easy way to make half rounds

With this setup for my table saw I have no trouble making half-round moldings from dowels. I made two blocks, each  $1\frac{1}{2}$ " by 3" by 5", and bored them lengthwise with a bit equal to the dowel diameter. Center slots as shown allow passage of the saw blade. Clamping screws in the blocks hold the dowel. I fastened one of the blocks permanently to a wood strip and provided screw holes to make the other adjustable. Last, I marked the sides of the blocks below the clamping screws for setting the height of the saw blade. It's simple if you follow the drawings.

PETER LEGON, Malden, Mass.



### Keep lint from clogging drain pipes

I had to dig a new dry well because my old one was clogged with dirt and lint that had drained from my automatic washing machine. But I won't have to do that again since I installed a Y connection in the drain pipe. It has a fine-mesh-screen strainer that catches all the dirt and lint before it can go down and clog the drain. The strainer is easily removed, after every two loads of laundry, just by taking out the plug on the unconnected side of the Y. All the parts needed to make this simple installation shouldn't cost you more than \$5.

R. F. CROOKER, Holden, Mass.



#### PARTS LIST

R1—250,000-ohm, 2-watt  
 potentiometer  
 R2—4,700-ohm,  $\frac{1}{2}$ -watt  
 carbon resistor  
 R3—220-ohm,  $\frac{1}{2}$ -watt car-  
 bon resistor  
 C—10-mfd., 15-volt elec-  
 trolytic capacitor  
 Q—GE X-10 unijunction  
 transistor  
 Speaker—4"-square loud-  
 speaker (4-ohm voice  
 coil)  
 SW—SPST toggle switch  
 Misc.—aluminum minibox  
 terminal strips, 9-vol-  
 transistor-radio battery  
 battery connector (snap-on  
 type), grommets

## HOW TO BUILD THE Magic Box That Goes

This low-cost electronic noisemaker ticks out time signals

By RONALD M. BENREY / PS Electronics Editor

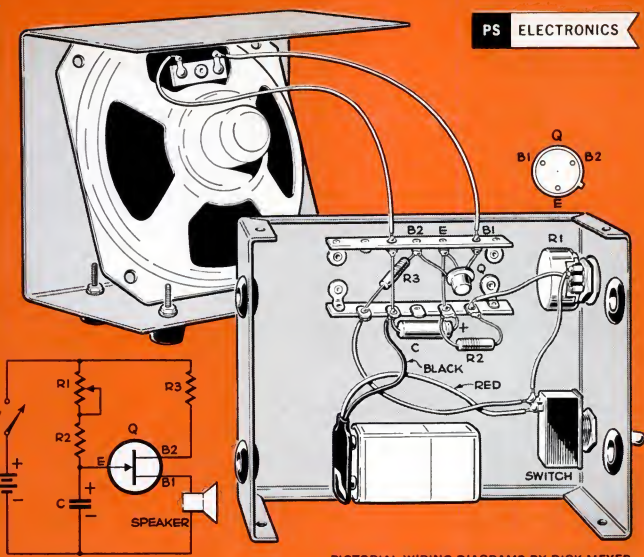
**T**urn this gadget on, and it starts clicking. Because you can vary the click rate with the turn of a knob—from about four clicks per second to more than one click every two seconds—what you've got is a talking clock:

- Set the click rate to exactly one click per second (by comparing the click rate with the sweep hand on a watch or clock), and you have an audible darkroom timing aid for gauging "dodging" and "burning-in" times with precision when enlarging.

- Set at quarter-note time, the gadget

makes a metronome when your kids practice on their musical instruments. The click volume is low, so it doesn't become obtrusive.

**How it works.** Heart of the circuit is a simple unijunction transistor oscillator. Transistor Q acts like an electronic switch that repeatedly dumps the electric charge stored in capacitor C through the voice coils of the loudspeaker. Each time this happens, the speaker emits a short click, and the capacitor immediately recharges in anticipation of the next click.



PICTORIAL WIRING DIAGRAMS BY DICK MEYER

# Click...Click...Click

u'll use in your darkroom or when you make music

The click rate—or number of clicks per second—is controlled by potentiometer R1. If you plan to use the gadget solely as a darkroom clicker, use a screwdriver-adjust pot instead of a conventional shaft-with-knob adjust unit. This will minimize the possibility that handling the unit will accidentally jar R1's setting and throw off the one-click-per-second calibration.

**Building it.** The circuit is housed in a 3"-by-4"-by-5" aluminum minibox. Drill several  $\frac{1}{8}$ " holes in the box to act as sound ports. Position them in front, and to the sides, of the speaker-mounting location. You can finish them off, as I did, by inserting a rubber grommet in each hole.

Wedge the 4"-square loudspeaker into the box front, as shown in the diagram, and cement it in place with epoxy. Be sure you don't let cement fall on the cone.

Mount two five-lug terminal strips to serve as soldering and mounting points for the other components. Double-check the polarity of C before you solder it in place, and be careful not to overheat Q when you solder its leads.

Cement the nine-volt battery in the position shown with a dab of epoxy. The battery should last about a year in normal use. When it does need replacement, break loose the cement bead, and install a new one in the same way.

# Spray Booth



**S**praying is the ideal way to finish many projects. But it's not always easy to find a safe place to do it, especially in cold weather when ventilation is a problem. Here's a collapsible booth you can use in a window of your workshop. It folds back flat against the wall when not in use. Or, if you mount it to the window with loose-pin butt hinges, you can easily take down the two hardboard assemblies and store them.

Mount an exhaust fan in the window to carry off fumes as you spray. But be sure the fan is not equipped with brushes or other sparking devices that could ignite paint fumes. A fan with a *shaded-pole motor* is the only one suitable.

Cut the side, top, and bottom panels from  $\frac{1}{8}$ " tempered hardboard. Four-mil plastic sheeting is heavy enough to protect the window from spray, cheap enough to be thrown away when covered with paint.



**1** Frame of one-by-threes is fastened to window casing with screws. Cut framing pieces to suit window size, butting top piece between the two verticals that rest on the window sills as shown here.



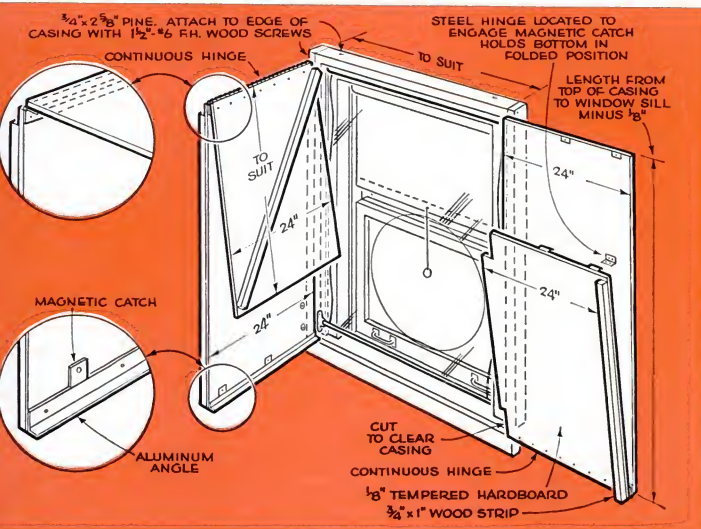
**2** Two hardboard assemblies are hinged together like this—the top to one side, bottom to the other. Sides in turn are hinged to window frame. For use, hold up the top, pull right side into place.



**3** Bottom of booth is dropped into place after right-hand assembly has been swung around at the top catches secured. Join top panels in each of two hardboard assemblies with piano hinges.

# for a Workshop Window

By FRANK L. GREENWALD



Aluminum angle riveted to left side supports bottom panel. Magnetic cupboard catches keep this corner together while the magnet is in use. Magnet on bottom can be adjusted by mounting slots.

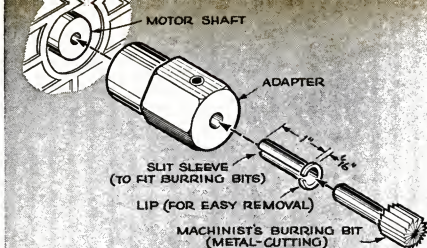


**5** To protect window from overspray, a four-mil plastic sheet was put on empty shade roller at window top. Note that a round hole was cut in the plastic to match diameter of exhaust-fan blades.



**6** Pair of window-shade brackets installed near the bottom of the window accept a 3/16" metal rod in a hem at bottom of plastic shade to keep the latter snug. Cut shade to exact fit along the sides.

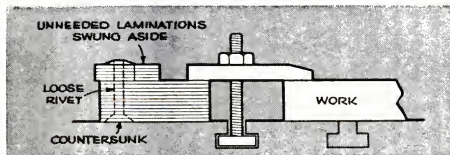
## Short Cuts for Machinists



### How to make your radial-arm saw carve metal

A homemade collet does it. It's made of  $\frac{3}{8}$ " drill rod and tempered to straw color. Outside diameter is machined about .005" smaller than the hole in the drill adapter, and the slot is  $\frac{1}{32}$ " wide. Hole in the collet is about .005" larger than the shanks of the burring bits you will use. To cut, feed the material against cutter rotation. The attachment is handy for making ornaments or for just shaving off excess metal.

GENE WEISS, Campbell, Calif.



### Stack of strips makes adjustable packing

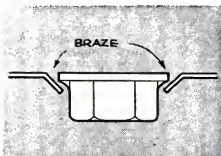
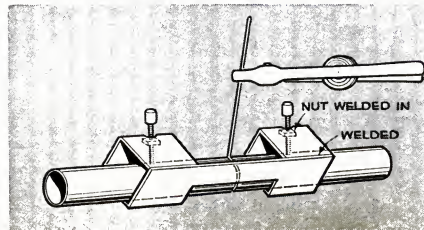
Core laminations from small transformers can end the hunt for packing of exactly the right height when setting up work on machine-tool tables. Straight strips are the easiest to work with, but you can use L-shaped ones by cutting off one leg. Use as many strips as needed; drill through the entire stack at one end and join with a loose flathead rivet or a bolt countersunk in the stack. To use the tool, swing excess strips out of the way, leaving enough to equal the height of the work.

HARRY WALTON, White Plains, N.Y.

### Clamp aligns round work for all-around welding

A few scraps of angle iron welded together as shown hold rods and pipe in alignment for welding. The cutout in the bottom angle iron lets you reach both sides of the parts to be joined. To mount the clamping bolts, drill holes through the centers of the two short angle irons on top and weld nuts across the holes.

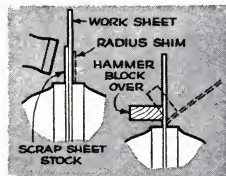
PETER LEGON, Malden, Mass.



### Brazing a nut flush with a sheet-metal surface

The secret is to first braze the nut to a larger flat washer with a hole bigger than the one in the nut. Make a concave impression the size of the washer in the sheet metal and braze the washer flush with the surface, with the nut facing downward.

A. DIXON, Meadow Lands, Pa.



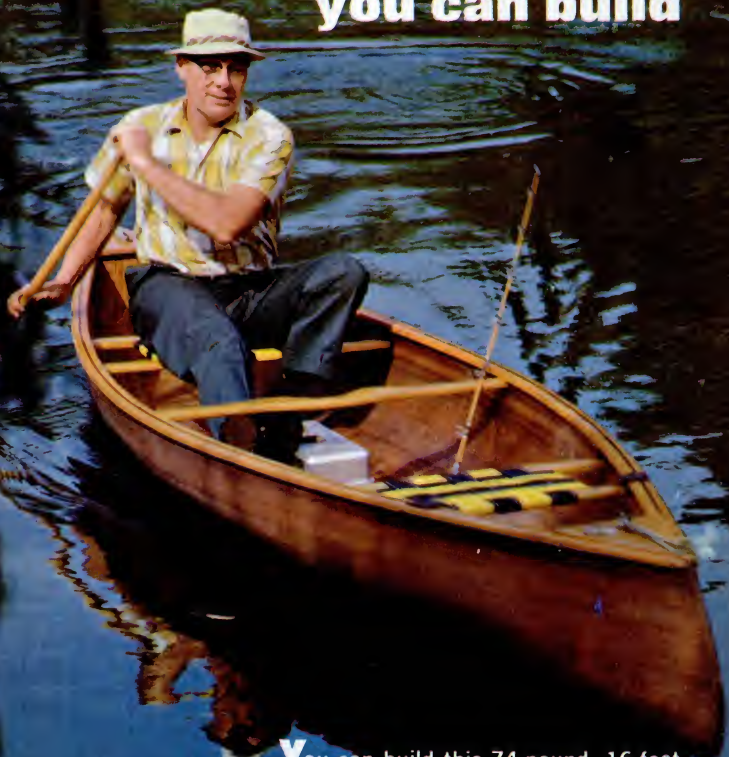
### Two ways to make clean bends in sheet metal

You can avoid hammer marks and wavy bends in sheet metal if you clamp it in a vise with a scrap piece in front of it and hammer on that. If a definite radius is required, clamp a rigid second piece as thick as the desired radius behind the work as well. For short bends there is an even quicker method—simply hold a block against the front of the sheet and hammer on the block, gradually tilting it upward as the sheet bends.

HARRY WALTON,  
White Plains, N.Y.

# REDWOOD CANOE

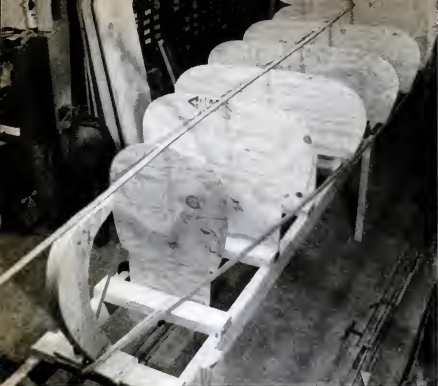
...a beauty  
you can build



By FLOYD McGUICKIN  
and JACK PAYNE

**Y**ou can build this 74-pound, 16-foot canoe for \$84. For a new canoe, that's a real bargain. You use redwood strips, an old boat-building technique, a lie-flat blueprint you'll find on the following pages. The





**1** Make the building form and attach templates to the crosspieces. Nail a strip down the center to hold the stems and templates in position.



**2** Redwood strips are tacked to the templates, and edge-glued. Drive brads through into the templates before putting on fiberglass cloth.

prototype canoe took about three weekends to build. She's broad of beam and flatbottomed amidship. Two persons can sit side by side in the center, with one person at each end and plenty of room for gear.

This canoe is formed around plywood templates using  $\frac{1}{4}$ "-by- $\frac{3}{4}$ " redwood strips, glued edge to edge. You lay up the strips, remove the form, and the canoe is complete, except for fiberglassing and putting in the seats.

**How to start.** First, lay out the patterns full size on large sheets of heavy brown wrapping paper. Since a canoe is symmetrical front to back and side to side, you need draw full-scale patterns of only half of each template, forming half of the canoe. The patterns are flopped to draw the other half of each template; duplicate templates are made from these for the other half of the canoe. Draw the template patterns using a  $1\frac{1}{2}$ " grid as shown in the blueprint.

Build the form from four two-by-fours. Make it square, solid, and level; the finished canoe will be no better than the form it's made on. If built as shown, it can be converted into a bench for working on the canoe right side up.

Cut the templates from  $\frac{1}{2}$ " plywood and screw them to the building form. Make sure they are centered and vertical. Put on templates 1 and 9 first; then stretch a string over the center of these between the ends. This lets you line up the other templates. Next, make the canoe's stempieces

and set them in place on the frame. Glue two pieces of white pine together for each stem, and trace the lines from the full-size drawing on each. Bevel each piece to accept the redwood side strips. Tie together the stempieces and the templates with a  $\frac{1}{4}$ "-square strip of wood.

Next, rip the longer straight-grain redwood planks (see Materials List) into strips  $\frac{1}{4}$ " wide. You need about 70 of these strips to make the canoe hull.

Before planking the hull, put masking tape along the edge of each template to keep glue from sticking to it. Start planking at the gunwales, using  $\frac{3}{8}$ " No. 18 brads to

**5** Reinforcing strips are put on each stem after the hull gets its first coat of resin. Hull is then covered with two layers of glass and resin.





**3** Bevel strips so they meet in front of stem. A tight fit is not necessary, since the stems are covered with two layers of cloth and resin.

nail each strip to the templates. Place the strips so that the  $\frac{1}{4}$ " width forms the thickness of the hull. Don't nail the strips to the endpieces yet.

After each strip is nailed in place, put Elmer's Glue-All along its edge. As you lay each strip in place, hold it firmly against the strip below and nail it to each plywood template.

Do this until you have three or four strips on each side in place. Then cut each strip off  $\frac{1}{2}$ " beyond the stempieces. With a sharp knife, cut the inside of the strips to an angle that lets them meet in a point

[See lie-flat blueprint on the following two pages. [Text continued on page 200](#)]

**6** Hull is placed in tilted position on the building form for easy working on inside. Only one layer of cloth and resin is needed on inside.



**4** Clamping jigs hold the strips in place when you reach the point where twist gets bad. Scraps from the beveled stem make good clamping pads.

beyond the stempieces. Glue them with resorcinol and nail them with  $\frac{3}{8}$ " copper nails.

A little ingenuity is needed to clamp the ends of the strips tight. A large rubber band (cut from an old inner tube) tightened with a stick through one end does a good job.

When you have added about 19 strips on each side, the twist at each end gets pretty bad. Clamps, shown in photos, hold them.

When about 25 are on, the strips meet along the keel. Cut them to meet in a staggered line along the keel.

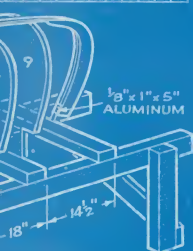
**7** Finishing touches include adding gunwales, inwales, seats, yoke, and breast plates. You weave seats with webbing as shown in blueprint.



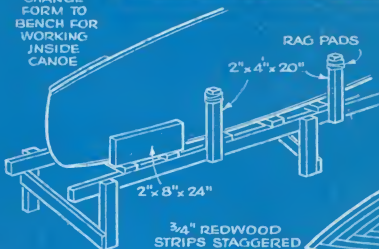


# PS LIE-FLAT BLUEPRINT

## REDWOOD CANOE



CHANGE  
FORM TO  
BENCH FOR  
WORKING  
INSIDE  
CANOE

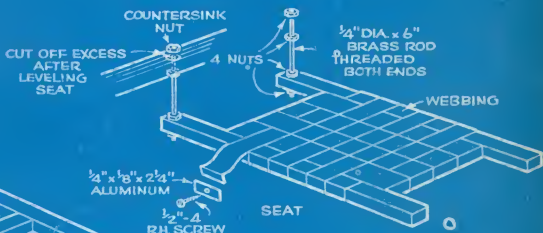


RAG PADS

2" x 4" x 20"

2" x 8" x 24"

3/4" REDWOOD  
STRIPS STAGGERED  
AT KEEL



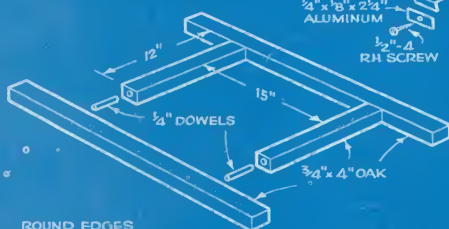
COUNTERSINK  
NUT

CUT OFF EXCESS  
AFTER  
LEVELING  
SEAT

1/4" DIA. x 6"  
BRASS ROD  
THREADED  
BOTH ENDS

WEBBING

SEAT



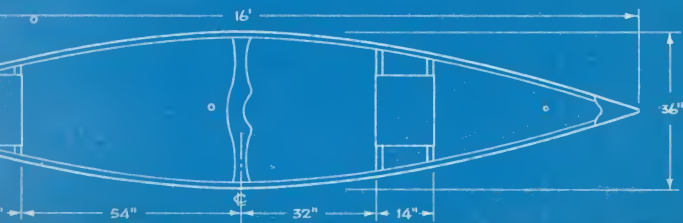
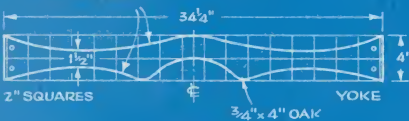
1/4" x 1/8" x 2 1/4"  
ALUMINUM

1/2" RH SCREW

### MATERIALS

- 4 pieces 2"x4"x16' straight-grain fir
- 1 panel 4'x8'x1/2" fir plywood
- 1 panel 4'x4'x1/2" fir plywood
- 2 pieces 1"x12"x17' or 18' straight-grain redwood (cut in 1/4" strips)
- 1 piece 1"x6"x14' straight-grain redwood (cut in 1/4" strips)
- 1 piece 1"x12"x7' clear white pine
- 1 piece 1"x4"x16' oak
- 1 piece 1"x4"x2' oak
- 1 piece 1"x10"x2' oak
- 3 gallons polyester or epoxy resin
- 11 yards 7 1/2-ounce, 60" wide glass cloth
- 16-ounce bottle quick-setting glue (Elmers Glue-All)
- 1 pint waterproof glue (resorcinol)
- 15 yards webbing for seats
- Nails, screws, sandpaper

ROUND EDGES



# Gus Puts an Offbeat Combo Back in Tune



The "Mourners" were a real go-go group, but they wouldn't be doing much going unless Gus could fix their antiquated heap

By MARTIN BUNN ILLUSTRATION BY RAY QUIGLEY

**T**hat Friday afternoon, the super-market parking lot was jammed. But Gus Wilson found the Plymouth station wagon exactly where Mrs. Landers had said it would be.

She hadn't told him it was bouncing with children. Five of them, from four to about 12 years old, were whooping it up inside. Through closed windows came the beat of rock-and-roll music from the radio. Gus rapped on a window. A golden-haired mop-pet of six rolled it down an inch.

"I'm not allowed to talk to strangers," she

announced firmly. "My mother says so!"

"Just tell me where to find your mother."

"In the library. She works there."

Gus tried again. "Where's Mrs. Landers?"

"She went back in the store for something she forgot. She said if you came to fix the car, go ahead. She'll be out."

"She's coming now!" bawled a boy, as a harassed-looking matron came to the car.

"You *were* quick," she said. "I'm so *glad*. My club is meeting at my house at seven and there are a *million* things to do and this battery's gone dead *again*."

Mrs. Landers fluttered out of the house. "My club people are due in 20 minutes," she wailed. "Please tow it away."



"Do you often leave the radio on while you're shopping?" asked Gus.

"Of course. It helps keep the children amused. They aren't all mine—I'm only minding three of them."

Gus refrained from comment on the risk of leaving ignition keys in a car full of kids.

"I'll check your battery," he said.

The starter responded with only a click. A hydrometer showed the 12-volt battery almost completely discharged. The fan belt was so loose it slipped in his fingers.

"I'm sure it's just the battery," said Mrs.

Landers, as Gus adjusted the belt tension. "The other times a man hooked on another battery and it started fine."

"Until next time," returned Gus. "So far, I find three reasons why your battery let you down, Mrs. Landers. Leaving the radio on when you're parked is one of them."

"How can that matter?" asked Mrs. Landers stiffly. "I don't even make long trips—just around town shopping and carrying about the children. Besides," she added triumphantly, "this car has an alternator. That always keeps the battery charged."

"Your short stop-and-go trips are the second reason," Gus continued. "In winter especially, when starter drain is extra heavy and you have to turn on headlights earlier, your alternator doesn't keep up."

"But they told me it would..."

"Alternators aren't magic, Mrs. Landers. They'll charge even at idling, but not with the motor off. Besides, the belt was slipping and not driving your alternator at full power. I've taken care of that."

"I'll put in a charged battery I brought along. We'll check and charge up yours and, when you come for it, I'll check the alternator output and the regulator."

With the Model Garage battery installed, the Plymouth started at once, its engine roar almost drowned out by cheers.

**Gus stayed late** that night, checking bills. He was about to quit at about 6:30, when the phone rang.

"Mr. Wilson?" an agitated feminine voice asked. "I'm in awful trouble."

"It's Mrs. Landers, isn't it?" asked Gus. "That battery didn't let you down?"

"Oh no, it's fine. I mean it's awful, but it isn't my car. It's that—that thing in our driveway. You must come and take it away—I don't care what it costs."

Though Gus wasn't eager to make a late service call, the woman sounded so upset that he hadn't the heart to refuse.

At the house, a long black vehicle loomed up in the driveway. It was a hearse! Its hood was up, and bobbing busily about it like acolytes were four black-garbed figures. Had he been called, Gus wondered, to get a stalled funeral moving?

He had another shock as he walked up. The four men, somberly dressed in black tuxedos, were all extremely young.

*Continued*

Mrs. Landers fluttered out of the house. "My club people are due in 20 minutes!" she wailed. "Please tow it away. It looks as if somebody died!"

One of the young men pushed forward, his thin, handsome face showing concern as the woman went back inside.

"I'm Bob Landers. Can you just tow us off? It's got my mother making like crazy."

Gus shook his head. "I didn't bring the truck. What are you doing with *this*?"

"We've got a combo going for weekend dances; call ourselves The Mourners. It's a gas. We play with deadpan, sourpuss faces. The gag goes over so big, we bought this crate to go to jobs in—it's a real blast at the scene."

"It's a 1950 Caddie and it goes pretty good," put in a tubby lad. "Only thing is,

caught at once. Gus turned the distributor back to the mark and locked it.

"Gosh, that was wonderful," breathed the Landers boy. "How'd you do it?"

"Never mind that now," returned Gus, seeing Mrs. Landers twitching in the doorway. "Get this thing out of here. If you still want to know, see me tomorrow."

The four piled into the hearse more like firemen than undertakers, and the unwieldy vehicle backed out. A still-grim Mrs. Landers pressed a bill on Gus.

**Before noon** next day, Stan Hicks, Gus's helper, opened the shop door in response to an imperious horn toot. In swept the hearse.

Stan's respectful mien underwent a startled change as the four young men tumbled out, dressed formally as before.

"We couldn't stand! not knowing," said Bob Landers to Gus, "even though we're on the way to our next stand."

"A grade-school afternoon dance," put in the redhead. "So we can pay you, if you'll tell us how you got it:

to start—and at double forte, too."

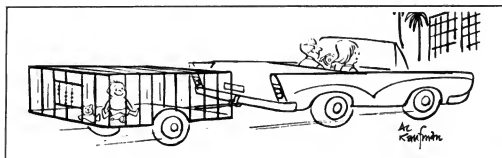
"I made a far-out guess," Gus began. "But first, what have you done besides putting in that hot new battery?"

A chorus answered. Distinguishable in it were a few words "new points," "coil," "spark plugs," "starter," "tune-up."

Gus held up a hand. "I guessed you'd tried all those, and that the ignition was okay. It isn't the first time I've run across an old engine with lots of mileage, and probably thick carbon deposits, which the starter can barely swing over when warm."

"It acts as if the battery's low, but that's not the trouble. When the engine is cold, raw gas coming into the cylinders takes a few milliseconds to fire up and explode. But when those carbon deposits are hot—and remember they boost compression, too—incoming fuel flashes into hot vapor that fires mighty fast. So fast, it happens before the top of the compression stroke. The explosions try to turn the engine backward, bucking the starter."

"Last night, I simply retarded the spark: more than the automatic advance allowed. You heard the engine turn over faster be-



it starts up fine cold, but won't when it's warm. When it quit here, while Bob was getting some music from the house . . ."

"It didn't quit!" hissed a redhead savagely. "You turned it off, Tubby."

"So I forgot! It was missing anyway."

"Let's just move it before those old birds of Mom's show up," put in Bob Landers hastily.

Gus leaned over the grimy engine. "Let's hear you try it," he suggested. He pulled off a spark-plug wire and held it near the block.

Sluggishly the engine turned over, hesitating periodically as if barely able to get past compression. But a good hot spark jumped from the cable to the block. Gus signaled to cut the motor, replaced the cable, and looked at the big six-volt battery.

"That's a 140-ampere-hour job," explained Landers. "We put it in last week."

Taking tools from his kit, Gus loosened the distributor lock nut. After scratching a position mark on the casing, he turned it to retard the spark about 10 degrees, and signaled the boy behind the wheel.

The engine spun briefly at fair speed, and

**You don't  
stay No.1 by standing still.**



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of product improvements. More powerful engines, up to 240 cu. in., heavy-duty clutches, stronger bumpers. They cover everything from stronger floor to reinforced roof. A new Select-Shift Cruise-O-Matic transmission is available for manual

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## **FORD ECONOLINE**

VAN AND SUPERVAN

**BOTH TURN  
IN THE SAME  
37' CIRCLE**



fore it started up. That was what did it."

There was a brief silence.

"How about leaving the spark like that so it'll always start up hot?" asked the tubby lad eagerly.

Gus shook his head. "You couldn't get out of your own way with it retarded."

The questioner's face drooped. "Thought if we knew the reason we could lick it."

"Well, you can—two ways. One is a pretty expensive engine overhaul—"

"We'll take the other," said Landers.

"Okay," chuckled Gus. "It's only a make-do fix, but easy and practical."

In the stock room, Gus picked up a hose clamp and a length of  $\frac{3}{16}$ " steel rod. He bent the hose clamp around the neck of the vacuum-advance unit on the distributor and secured it. He then drilled a  $\frac{1}{8}$ " hole in the firewall in line with the clamp.

Having made a short L bend at one end of the long rod, he passed it through the hole and hooked the bent end into the hose clamp. Under the dash, he made a larger L bend at the other end of the rod. Then he loosened the distributor lock nut until a 10-pound pull on the rod would rotate the distributor casing. But he set the rod at the original advance mark on the casing.

"Start her up," said Gus.

Bob Landers turned the key. The starter churned as slowly as before.

Reaching for the rod, Gus slowly pushed it in. The starter picked up speed. He moved the rod farther. Abruptly the engine fired up. As it idled, Gus detected a slight kick in its beat.

He got out to file a nick in the rod at the

firewall. Then he connected a timing light, pushing on the rod to advance the spark until the timing mark lined up. Then he filed a second notch in the rod.

"You'll feel those nicks drop into the hole," he explained as he disconnected the light. "Push the rod forward to start, pull it back to the other nick for running. But don't forget that, or the engine will have no pep, and will overheat besides. Now, what have you done about that miss?"

"Nothing," responded the redhead. "We just put in new plugs so it must be a warped or stuck valve."

"Did you gap the new plugs first?"

"Fellow we bought 'em from did."

Gus got his oscilloscope plug checker and hooked it up. At once seven normal traces slid up the screen. The eighth fell far short.

"Which of you dropped number-five plug?" asked Gus with a grin.

"How'd . . . Did that gadget tell you that?"

Gus nodded, shut off the engine, removed the damaged plug, and held it out.

"See where it landed on the electrode? That closed the gap. There was no spark."

Gus reset the gap with a gauge, then screwed the plug back in. Restarted, the engine ran smoothly.

"You're okay, Mr. Wilson," said Landers.

"Okay? He's great," declared the redhead. "How much is the bill?"

"Mrs. Landers paid me enough last night to cover this," Gus said. "But there is one thing you can do for me—"

"Just name it!" said the tubby one.

"Move it out," begged Gus, "before somebody comes in—and takes the Model Garage for the morgue." [5]



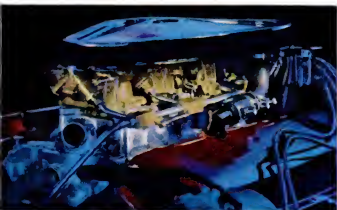
### Passing motorists play Good Samaritan

One driver can help another without a stop—just by blinking his lights—in an experimental system shown here in a trial on New York's Long Island Expressway. The sign at left asks any driver seeing a disabled vehicle along the

highway to signal by flashing his headlights three times, at a point a quarter-mile ahead. An electronic recording device installed beside a second sign (right) relays the message to the highway patrol's headquarters. The project is being conducted by the Airborne Instruments Laboratory for the U.S. Bureau of Public Roads.

# Chevrolet warrants all its high-performance engines for 5 years or 50,000 miles.

(Including both our 396s and all four of our 427s)



## 427-cubic-inch Turbo-Jet

We trust every engine we build. That's why we give our high-performance jobs the same 5-year 50,000-mile power train warranty we offer on all our other engines. Here it is:

*Chevrolet . . . warrants the power train components specifically described as the cylinder block and head and all internal engine parts, intake manifold, transmission case and all internal parts, torque converter, propeller shaft and universal joints, differential, axle shafts and rear wheel bearings on any such Vehicle, manufactured or supplied by it to be free from defects in material and workmanship under normal use and service for 5 years or until it has been driven for 50,000 miles after such delivery, whichever occurs first.*

*As an express condition of this warranty, once every 6 months the owner is required to furnish an authorized Chevrolet Dealer evidence that the engine oil, oil filter, carburetor air filter, and positive crankcase ventilator valve (and automatic transmission oil and transmission band if so equipped) have been serviced in accordance with Chevrolet's required maintenance schedule as stated in the applicable Chevrolet Owner Protection Plan booklet, and have the Dealer certify in such booklet (1) that he has received such evidence, and (2) the then current indicated mileage on the odometer.*

*Chevrolet's obligation under this warranty is limited to repairing or replacing any part or parts which are returned to an authorized Chevrolet Dealer at such Dealer's place of business and which examination shall disclose to Chevrolet's reasonable satisfaction to have been thus defective. The repair or replacement of defective parts under this warranty will be made by such Dealer without charge for parts and labor.*

*The provisions of this warranty shall not apply to any Vehicle which has been subject to misuse, negligence, alteration or accident, or which shall have been repaired outside of an authorized Chevrolet Dealer's place of business in any way so as, in the reasonable judgment of Chevrolet, to affect adversely its performance and reliability, nor to normal maintenance services (such as engine tune-up, fuel system cleaning, carbon or sludge removal, brake and clutch adjustments and wheel alignment and balancing) and the replacement of service items (such as spark plugs, ignition points, positive crankcase ventilator valves, filters and brake and clutch lining) made in connection with such services, nor to normal deterioration of soft trim and appearance items due to wear and exposure.*

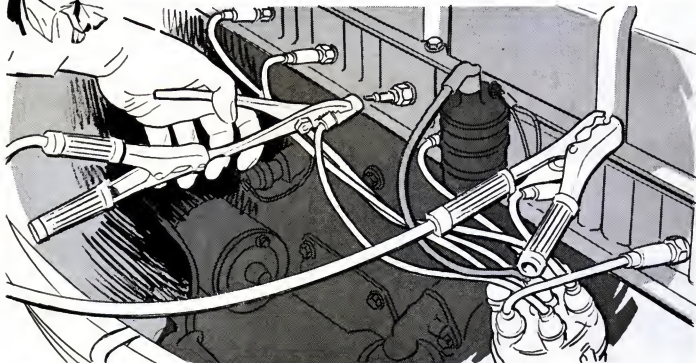
*This warranty is expressly in lieu of any other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of Chevrolet, and Chevrolet neither assumes nor authorizes any other person to assume for it any other liability in connection with such Vehicle. Enough said.*





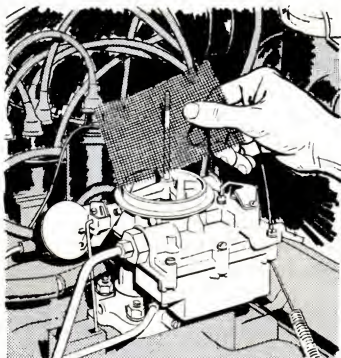
# Hints from the Model Garage

DRAWINGS BY  
DAN TODD

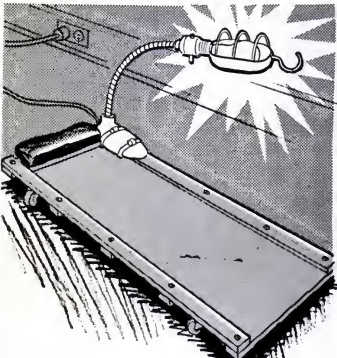


When pulling spark-plug leads off the plugs, one by one, to test the spark or to locate misfiring, you can avoid electrical shocks by clamping one end of a battery jumper cable to a pair of pliers and the other end to a ground connection.

The plug leads can then be handled with the pliers. Any high-voltage leakage will be grounded through the jumper cable, not through you. If the leads are loose, an easier way to handle them is with the cable's alligator clips.



When working on an engine while the air cleaner is removed, here's how to make sure you won't drop anything into the carburetor throat: Shape a piece of wire screening to slip down over the air-cleaner hold-down bolt on top of the carburetor body. Don't forget to remove the screen before replacing the air cleaner.



A trouble lamp permanently attached to your creeper board is a handy thing, and a gooseneck standard is perfect for the job. It gives steady light; it can be adjusted to any position to throw the light where you want it; and it is easily attachable—a simple metal strap or two will hold it securely in place on the board.



## This little black box contains the biggest advance in outboards since the first Sea-Horse V-4

It's the real heart of **POWER/PULSE** ignition — free of breakers, points, condensers. Gives you all the advantages of all-electronic "solid-state" design! Brand New In our '67 Golden Meteor V-100!

**ELIMINATING THE CONDENSERS AND BREAKERS**, along with breaker point wear and replacement, is just the start of it.

All-electronic Power/Pulse ignition shoots the juice to the V-100's spark plugs 20 times faster than conventional coil and breaker systems. Whipcrack action sparks instant starts... followed by smoothness never before achieved in a 2-cycle engine. Uncanny smoothness at every speed, even the slowest idle, regardless of the engine's state of tune. What's more, this rapid-fire ignition has a profound anti-fouling effect on spark plugs — an effect matched by the erosion-

resistant nature of the new surface-gap plugs used in the Golden Meteor — to give you vastly extended spark plug life.

No other outboard in the 100-hp class gives you so much. Exclusive Electramatic drive, with single throttle-shift lever, results

in precise control of the tremendous yet effortless thrust this high-torque V-4 puts out, even with capacity loads. Efficient engineering makes Golden Meteor the fastest-moving fuel miser of all outboards — and that's on regular-grade fuel in our 50 to 1 gas/oil mix. Johnson's famous dependability features include full corrosion protection — no flushing out after running in salt water — all adding up to our famous two-year warranty.\*

Check out the V-100 and the 17 other great Sea-Horse models at your Johnson Dealer's (he's in the Yellow Pages) . . . or write direct for free Sea-Horse catalog. Johnson Motors, Waukegan, Illinois 60085. Dept. PS-37.

\*For 24 months after purchase, Johnson Motors will replace without cost to the original purchaser any part of its manufacture which, upon inspection, proves to have failed in normal pleasure use due to faulty material or workmanship.

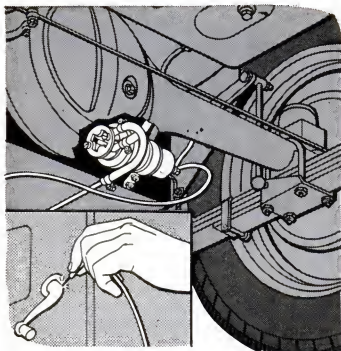


# Johnson

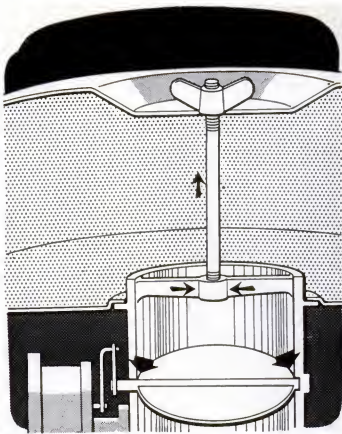
Find in dependability — **Sea-Horse motors**, Sea-Foil boats, Air-Buoy dive gear, Skee-Horse snowmobiles • Division Outboard Marine Corporation



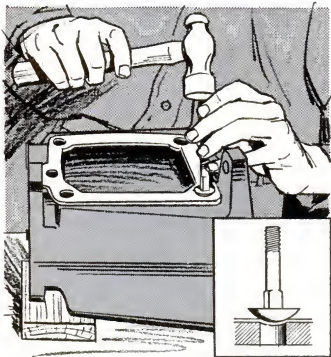
## More Hints from the Model Garage



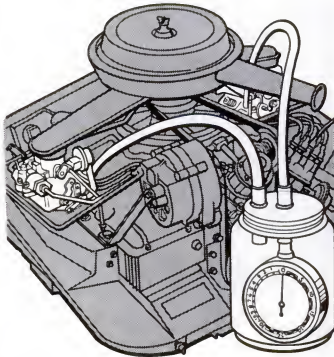
If the electric fuel pump on your sports car quits because the points overheat and stick, you can still make it to a repair shop. Run a length of insulated wire from the pump's hot terminal to the cockpit. Expose the other end and you can operate the pump manually by grounding it.



A sticking choke valve can be caused by contraction in the carburetor body near the intake port. Overtightening wingnuts that hold the air cleaners can force the port sides together (see arrows). When this happens, the choke valve can be filed or ground to a free fit.



You can put clean, accurate holes in a home-made replacement gasket by using the head of a carriage bolt as a punch. Hold the gasket material over the hole. The bolt will center itself on the hole and automatically give you the size hole you need when you tap on the bolt.



Only one vacuum gauge is needed to adjust twin carbs on Corvairs if it's placed inside a sealed jar, with two soldered fittings connected to the carburetor vacuum inlets (one with the gauge, the other to create partial vacuum). With a zero reading, you have perfect balance.

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There's more to the new INTERNATIONAL pickup than meets the eye. Behind its bright new styling you'll find all the big new features you want—a tough truck-styled chassis, sturdier suspension, heavy gauge body, better paint and rust protection, plus new steering for real ease of handling!

And, you'll find INTERNATIONAL'S out front again with the most complete standard safety package available, bigger, more positive brakes, and new custom interiors that include optional *bucket seats*! Drive in to your nearest INTERNATIONAL Dealer and see the new 67's. Then see the great new deal he's ready to make. International Harvester Company, Chicago, Illinois 60611.

**IH** INTERNATIONAL TRUCKS

Typical spots where home owners must fight rust



## Your Personal Battle with Rust

There's one important rule for coming out the victor: Keep your metal dry and keep it painted

By JACKSON HAND

**M**etals hate being metal. They'd rather be some sort of an oxide. Give them half a chance and they change. This costs you money.

Reliable estimates place the bill for corrosion and rust at an average of more than \$100 a year per family. Families in bone-dry Tucson pay less. Families in Manitowoc, on Lake Michigan, pay more. The bill is for metal objects that are reduced in value or ruined completely because chemistry changes them to some other form.

You can never stop corrosion entirely. But you can keep it within reasonable limits. The trick is simple: Keep the metal dry. That is why the man in Tucson has it lucky. In the middle of a desert, keeping metal dry is duck soup. For the man in Manitowoc\* it is not so simple. He must keep it from getting wet. He must also keep moist air from getting into contact with it. In an industrial area, he must worry, also, about such things as sulfur dioxide in the air, because it will speed rusting at a tremendous rate.

**Two approaches.** There are two ways to keep metal isolated from the water and the air (primarily the oxygen) that help cause corrosion:

- Keep the metal in a place where the air is dry. When humidity is 60 percent or lower, rust is negligible. That's why a dehumidifier may be a good investment in a basement workshop in summer. With no further precautions, it will keep tools from rusting, and may even keep your hands free from the salty perspiration that etches fingerprints into steel.

- Cover the metal with something to keep water and airborne moisture-vapor from touching it. For a rifle, for

*Continued*

\*Manitowoc, Mich., is among 50 U.S. cities suffering great loss from rust, according to corrosion studies. Buffalo is worse. So are Los Angeles and Chicago.

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## Your Personal Battle with Rust

example, this can be a polyethylene bag containing silica gel to absorb the moisture. For a car, a bicycle, a porch railing, or any other hard-to-package item, it boils down to one form or another of paint.

**Priming.** When you talk about painting metal, you're talking about a primer which stands guard against rust, plus a film to protect the primer. In some systems, the primer goes on as a first coat (or two coats for a top-grade job) followed by the top-coating. In other systems, the primer is incorporated in an extra-quality enamel-type vehicle, which combines the anti-rust-ant and built-in protection for it. Often the two-in-one material is used in two or three coats, multiplying the amount and degree of protection.

Primers are important in metal finishing. They provide an initial adhesion and an ideal base for topcoatings. Properly formulated, they contain ingredients to create a negative environment for rust. In a general way, the chemistry of rusting requires an acid condition that encourages electrolysis—much as a storage battery operates. To prevent this, a primer interferes with the conditions that permit electrolysis—usually by alkalizing the acid as fast as it forms. Ordinary paints cannot do this. Once water penetrates them, rust begins, and multiplies on its own acidity. Then away goes your finish.

**Surface preparation.** Parallel to the primer in importance is preparation of the surface. You'll run into two kinds: on new metal and on previously finished metal. They present somewhat different problems, although the problems may overlap.

Let's start with previously painted metal.

1. Inspect the surface carefully, not only for obvious defects but for small lumps on an otherwise smooth and intact surface. These are often minute pinholes in the finish through which moisture has entered and started a rust tubercle—a tiny pit that becomes larger and deeper, often going completely through sheet metal in a short time.

2. Scrape and finish imperfections in the bare metal and far enough all around to make sure you are into sound metal. But there's no point in going too far. Flint sandpaper will usually cut rust and paint without cutting metal. Use aluminum oxide or emery paper if you want to smooth the

actual metal. A power sander will speed up the job for you.

3. If a major portion of the old finished surface is bad, you'll be delighted at how fast a paint-and-varnish remover takes paint off metal, cutting through and riding along the surface.

4. If you can, take off all rust, right to the bare metal. If you can't, be sure that all loose, flaking rust is scraped and wire-brushed away. Wipe with a cloth dampened in mineral spirits. Now you're ready to prime.

How about preparing unpainted metal?

1. Remove all rust—again to clean bright metal if possible, but at least down to sound rust.

2. Aluminum's whitish "rust" comes off easily with detergent and warm water.

3. Copper's greenish "verdigris" must be sand off.

4. New galvanized metal is usually coated with processing oils. There may be a gray-white oxide on older galvanized surfaces. Both of these come off with warm water and detergent. For best results, galvanized needs an application of phosphate chemical conditioner—available at paint stores. The phosphate improves adhesion, notably bad on galvanized metal.

**Mill scale.** New steel may have a hard blue-black coating, called "mill scale," which is caused by heat and pressure during the hot rolling process. It is composed of oxides that resist rusting. But this layer is soon penetrated by water, acids start to form, the mill scale acts as the cathode, the steel as the anode, and there is your galvanic action—rust, but plenty.

Mill scale is hard to remove, except by sandblasting or industrial pickling solutions; the average man around the house can't handle the problem. What's the best thing to do? Just let the galvanic action rust the mill scale, then scrape off the rust and apply the finish.

**What's on the market.** The key rust-inhibiting chemicals today are red lead, basic lead silicochromate, and zinc chromate, all of which are used in primers any paint store sells. (Now making their way into stores are primers containing calcium and other molybdates with excellent rust-inhibiting qualities plus a very low toxicity.) Each is formulated, along with other active chemical ingredients, in a vari-



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WORLD LEADER IN SOLDERING TOOLS

## Your Personal Battle with Rust

ety of oil, alkyd, epoxy, vinyl, acrylic, and other bases. Each has its advantages.

Many experts believe that red lead is being superseded by the other materials. One reason why is the dark, unalterable color of red lead. The pale colors of the others permit them to be used in a paint of any color, an important factor when primer and topcoat are combined in one product. Another disadvantage of red lead is that you can use it on steel only, while other materials are more versatile. The old—and largely fallacious—idea that you can use red lead in oil on rusted steel that is less than dry is losing credence. It can be done, but the result is far from perfect. When you must work in a damp area (such as a basement), pick up a red-lead primer in an acrylic emulsion, since the emulsion paints *really* work in dampness. This primer, topcoated with an alkyd enamel, gives superior performance.

Red lead has the disadvantage of being "harmful if eaten," as the required labeling says. This precludes its use on such items as food-preparation machinery and the like.

**Things to come.** Some new things are in the offing—already in use industrially and perhaps due for the public soon.

One is National Lead's "defense in depth" program—coating minute silicate particles with lead chromate so that less lead is required. In effect, the idea is that only the lead that is *in contact* with the rust-causing substances is doing anything about rust, and that more lead can be put in contact through the coating system. This is leading toward primers that act as finished coatings without sacrificing value as primers.

Another is DuPont's barium lanolate system, which uses neither red lead nor zinc chromate. Instead, it is a mixture of pigments that are as low as possible in water-soluble salts. Since there are no chemical solutions, there are no osmotic pressures. Water penetrates to a lesser degree. What moisture does reach the base metal is not sufficiently electrolytic to cause rusting, because any salts in solution are precipitated by special ingredients—mainly barium lanolate. This ultra-sophisticated method of keeping metal "dry" is used purely for priming and must be topcoated.

A third forward step is in progress at Rohm & Haas, where special acrylic resins have been developed to retard underfilm

*Continued*

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The other side of Chevy's character is this. It's newly styled to please for commuting, camping or what have you. Dress it all the way up with bucket seats, carpeting and a choice of automatic transmissions if you wish. But even beyond the looks, the new Chevy Fleetside rides and handles like a passenger car. Makes it a real pleasure for everyone in the family to drive. Stop by your Chevy dealer's soon. . . . Chevrolet Division of General Motors, Detroit, Michigan.



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## Your Personal Battle with Rust

rusting. This means that an acrylic paint could become its own primer over metals, such as rusted, repainted gutters and downspouts. More important, it would end rusting of nailheads under emulsion house paints. This material has not yet made an appearance on dealers' shelves.

Quite a way off as far as the average man is concerned is a metal protectant based on silicones. In liquid form, it is wiped or brushed on metal that must be virgin clean—not even a fingerprint. It provides superb protection by keeping moisture away from the metal and its advantage is that moisture and rust or corrosion cannot creep beneath it if it is punctured or scratched through. The material is very tender to abrasion, must be topcoated, and as of now is being recommended only for use indoors by such people as metal-cabinet manufacturers. There is no way for a home owner to get hold of it at present—and he couldn't handle it if he had it. Manufacturers, including Union Carbide and other producers of silicone products, expect that when the metal protectant does reach consumers, it will quite likely be in the form of spray cans.

**Proper priming.** The thickness of a primer layer contributes directly to its effectiveness and life as a rust inhibitor.

When you prime, don't brush out. Lay the coating on as thick as possible without sags. Take special pains where two metals join, and around rivets, where metallic differences and stresses can set up electromotive potentials. Double up on corners, where wear may be greatest.

Many experienced painters like to spot-prime the danger points, then prime the entire job, thus double-coating the metal where it needs priming most.

Two coats of primer, in fact, are better than one in most cases. A good way to make sure you cover is to put a trace of tinting color in the second coat, so the difference will show. Sand off just the high spots between coats. Sand the second coat as smooth as you want it to be—but don't cut through, or the rust inhibition will be gone, of course.

You pick a topcoat for primed metal on the basis of where the metal is and what it does: trim and shutter, wrought-iron black, enamel, regular house paint—whatever the job requires.



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in the world's most powerful outboards.**

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## Now Everyone Can Use Lacquers

(Continued from page 153)

Thin every coat of lacquer, not just the first as you do with enamel and varnish. While it is true that this reduces the effective solids in each coat, it may save time and materials by reducing the amount of build you'd sand off trying to make brush marks smooth.

● **Spraying.** Always spray lacquer if you can. Spray cans are an excellent bargain in quality and usefulness—except for big jobs on which too many cans would boost the cost. The quality of reputedly produced spray-can lacquer is close to that of the good bulk spraying lacquers, and even outdoors runs a close second to high-grade alkyd enamel. One paint expert puts it this way: “You might get one more season out of a captain's chair done with enamel, but the spray-can lacquer is so quick to use it makes up for the difference.”

**The color range.** Spray cans offer a range of colors wide enough to meet just about any requirement—particularly if you include such lines as Dupli-Color, sold at Western Auto and similar stores, made to match dozens of recent automobile colors.

If you work with a regular spray gun, you can buy bulk lacquer at any good auto-supply outlet, although it is hard to find at paint stores except in black, red, and other standard colors.

Any brush-on clear lacquer works perfectly in a regular spray gun, too, including Fabulon, Satinlac, Rez-20, and others.

Proper viscosity is critical if you want to avoid “orange peel” and other surface defects. Most materials come too thick. An excellent method of arriving at the ideal viscosity is through the use of an inexpensive device such as the Sprayit Vis-cos-i-meter, made by Thomas Industries. It's a cup of known capacity with a hole in the bottom. You measure the time it takes for a cupful of a material to drain, adding thinner until it drains in the required interval.

**Brushes for the job.** Because lacquer sets quickly and must be brushed as smoothly as possible, you may want to invest in a sable or other fine-hair brush and reserve it for lacquer. Never use a brush that has been used for varnish, enamel, or paint. No matter how carefully you clean it, the lacquer solvents will loosen dirt and deposit it on your lacquered surface.

**Lacquering old finishes.** Lacquer can

*Continued*

# Scratch this page and you'll see what's been wrong with print-grain panelings ...until now.

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Simple. It also mills, drills, grinds, polishes and more. That's UNIMAT, a miniature machine shop that operates both as a precision lathe and multi-functional tool on metal, plastic and wood. Converts in just seconds. Only 17" long, UNIMAT has satisfied thousands of exacting hobbyists with its versatility and tool-room accuracy (up to .0005"). Performs like costly big equipment while taking up a minimum of space. Techniques", a 40-page



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## Now Everyone Can Use Lacquers

always be used over old lacquer. In fact, a new topcoating often rejuvenates an old finish that shows its age. It is unsafe to use lacquer over other existing finishes, however. Some of the strong solvents in typical lacquer formulas are quite similar to those used in paint and varnish removers. If for any reason you feel impelled to lacquer over a nonlacquer base, make a test for drying on an inconspicuous spot.

**A typical lacquer-finishing schedule.** For a fine finish, follow these steps:

1. Sand and dust as carefully as possible. Use a tack rag, but be sure it is dry enough so that it leaves no oil.

2. Seal. Use a sanding sealer that is lacquer-based. Or brush on a first coat of lacquer, thinned one part thinner to three parts lacquer. Do not mix materials. That is, don't use an oleoresinous sealer—or shellac. If you fill, use a lacquer-based filler or let a regular filler dry 72 hours or more. Otherwise, the lacquer may soften it and bleed the colors.

(If you stain the wood, avoid adhesion failure or drying problems by using a water stain or non-grain-raising type.)

3. After sanding and dusting the first coat or seal, thin the lacquer to best brush or spray consistency and apply it full but not too heavy. Overthick coatings don't harden well, and may sag on vertical surfaces. Give the coat at least double the drying time printed on the label.

4. Sand only enough to remove surface blemishes. Do not use water and waterproof paper. Stick with 6/0 or finer aluminum-oxide or garnet paper, used dry.

5. Continue until you have built sufficient film. Pay careful attention to edges; sometimes lacquer mysteriously pulls away from an edge and you must deliberately over-wet the area, then lift off the excess with bristle tips.

6. When you have built up a film of lacquer, you can leave it glossy (or satiny, in the case of low-gloss materials) or you can rub it for a perfectly smooth nongloss finish. Take special pains to avoid dust if the finish is not to be rubbed. Rub with 400 or finer waterproof paper used with a rubber sanding block, or with pumice and oil on a felt block. Lacquer responds particularly well to rubbing compound on a lamb's-wool buffer, followed with automobile polisher. The result: a sheen without gloss.

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## Redwood Canoe You Can Build

[Continued from page 173]

When all strips are in place, sand the hull and give the outside a coat of polyester or epoxy resin. When this has set, make a thin-point nail set and punch all nails in each strip through, into the form.

Cover the outside with glass cloth and another coat of resin. Start at the center and work the cloth toward each end. A few staples hold it while you apply the resin.

Use inexpensive paintbrushes to apply the resin. Wear rubber gloves, and use a squeegee to work the resin through fiberglass. After the first coat of resin, fit an extra strip of fiberglass at each end to overlap about 2" on each side.

When the resin is set, sand the rough spots and apply the second coat. Two coats of cloth and resin should be enough.

**Removing the templates.** After the outside is finished, take out the screws that hold the templates to the form, and carefully remove the templates. To do this, push them toward the larger part of the hull. Turn the canoe right side up on the building form to work on the inside.

Sand the inside and coat it with resin. Shape and attach the keel before glassing

and finishing the interior. The blueprint shows how to change the building form to hold the canoe at an angle; it makes working inside easier.

Cover only half of the inside at a time. This lets you overlap the glass at the center for more strength. Before putting in the full-length glass cloth, work some left-over pieces in at the stems.

You can cut 60"-wide cloth in half and staple the selvage about  $\frac{3}{4}$ " over the center line so that the keel screws are covered. Work it up the sides and toward each end. A few staples may be needed along the top edge until the resin is on; they may then be pulled out. One layer of resin and cloth is enough inside.

When the resin is set, trim off the excess glass cloth. Attach the gunwales and inwales with either screws or bolts.

Build and varnish the seats, breast plates, and yoke, and fasten them in place.

These plans let you build a 13' canoe, too. You build it the same way, but you eliminate templates 4 and 5, making template 6 the center of the hull. Nothing else need be changed.

19

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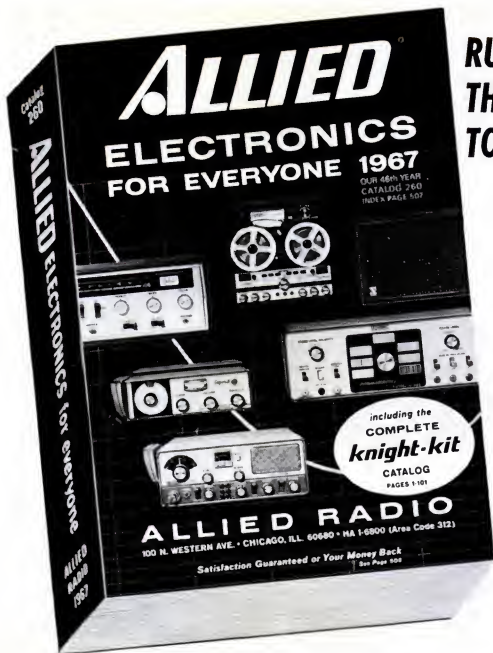
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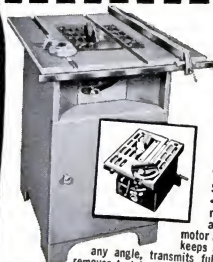
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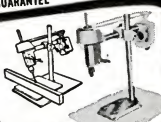
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206 | POPULAR SCIENCE

## Bringing Spacemen Down on Land

*(Continued from page 87)*

The Apollo Command Module has a limited capability for returning to solid earth—a land landing is acceptable only in dire emergency, like ditching an airliner in the ocean. The impact may subject the crew to up to 40 g's, even on favorable terrain and despite the cushioning effects of the crushable honeycomb heat shield and the shock absorbers in which Apollo crew couches are suspended.

**What's needed.** To convert this emergency capability into an acceptable operational capability, the Apollo land-landing system must meet these requirements:

- The landing area will be a specified but unprepared zone, approximately 10 miles in diameter.

- The landing system must be able to operate in surface winds up to 40 feet per second (27 m.p.h.), and must permit upwind landings.

- The spacecraft must be steerable during descent, to avoid hazardous obstacles and to offset surface winds.

- The crew must be able to see the touchdown point.

- The spacecraft must not tumble or roll over on contact with the ground.

- The system should have minimum weight and bulk.

- It must be compatible with launch abort requirements.

- Since 70 percent of the globe is covered with water, the spacecraft's ability to land in the sea must not be impaired.

**Best bet—a steerable chute.** A kind of steerable parachute, stowable as compactly as Apollo's present triple parachute, emerges as the most promising device for a controlled glide to a ground landing.

One example is the Para-Sail, invented by Pierre Lemoigne, a French aeronautical engineer. Designed as a towable kitelike chute for sport, it turns out to perform well for spacecraft use, too.

The cloth of the Para-Sail is almost impervious to air, unlike the porous cloth of a standard parachute. Air flowing upward and rearward through slots creates a downward thrust on the lee side, making the canopy assume a glide angle with respect to the air stream. Air flow over the leading surface, producing a lift force, further increases the gliding angle. Circumferential slots—opened, closed, or inverted by

**Bringing Spacemen Down on Land**  
control lines—enable the Para-Sail to yaw around and change the heading of its glide path. The Pioneer Parachute Co., which in 1962 acquired license rights for the LeMoigne Para-Sail, has begun a major program to apply its principle to steerable spacecraft chutes.

Other efforts along similar lines include Cloverleaf and Glidesail types of Northrop parachutes, the Sail Wing developed by Parrish Associates, and even rotor-blade landing devices.

One major consideration in selecting the best system for the Apollo spacecraft will be whether it offers the safety feature of redundancy, as do the three parachutes of Apollo's present nonsteerable landing system. Should one of these parachutes fail, a water landing can still be made safely with the other two.

If the need to see the touchdown point to be met by looking out the spacecraft's windows, the crew will have to ride down in a sitting position, which will require changing the way the Apollo Command Module is suspended from chutes. The present way, which lands the astronauts lying on their backs, would call for direct viewing via a television camera and a screen on the instrument panel.

Unaided, even a steerable parachute would have to be impractically large and heavy to bring down a manned spacecraft on land as gently as we aim to do. The present Apollo spacecraft splashes down at 3 feet per second (19 m.p.h.) with all three parachutes deployed, and at a still tolerable 34 feet per second (23 m.p.h.) on two chutes. But we plan a much slower descent to a land landing, at something like eight feet per second (5½ m.p.h.).

**A rocket brake.** A likely answer is to slow the descent just before impact with an array of small downward-firing rockets, ignited a few feet above the ground. The rockets may be embedded in the Command Module and fired through the periphery of the heat shield—or, alternatively, placed on the parachute risers.

The remaining shock of impact will be cushioned either by leg-type landing gear, or by crushable material inserted between the heat shield and the interior structure of the spacecraft. Supports extended shortly before touchdown will prevent the capsule from tumbling after landing.

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## Fly with Me in the New Jumbo Jet

[Continued from page 101]

terminal area, the autopilot is turned on. From here on, the journey will be a matter of flight management by captain and crew, supervising the performance of the airplane and checking the instrumentation. The autopilot will respond precisely to orders from an automatic navigation system.

**Cruising over the Atlantic.** In 36 minutes we reach our assigned cruise altitude.

Through the automatic flight-control integrated system, the captain turns a knob to fix our ocean-spanning speed at 526 knots. The thrust levers—the throttles—adjust themselves to that speed.

Back in the passenger compartment, pressurized to a simulated 6,000 feet, the FASTEN SEAT BELTS sign winks off. At one of four telephone stations in the cabin, one of our 18 stewardesses advises the flight deck that Passenger Smith of Moline, Ill., wants to telephone his home. The flight engineer puts the call through—relayed via a communications satellite 22,000 miles above the earth. The same satellite provides our airplane with perfect voice communication with America and Europe throughout our flight. The days of radio interference are gone forever. If this were a daytime flight, the satellite would be providing us with current headline news and stock-market quotations.

By 11 p.m., New York time, most of the passengers, having seen the movie on one of four screens and had a full meal, have gone to sleep. Already they are halfway across the Atlantic.

Eighteen minutes, or 180 nautical miles short of Paris, our plane starts its descent schedule—the glide for Orly Airport. The engines—automatically—are cut back to idle thrust. We descend at 2,200 feet a minute at an indicated air speed of 340 knots.

Orly has advised us that a light snowfall has reduced the runway visual range to 750 feet. It has not mentioned ceiling. I didn't have to. We are going to make a fully automatic, all-weather landing. Under this system airliners can land even when the birds are walking.

When we are 30 miles from Orly, we're down to 10,000 feet. The captain turns a knob on the autopilot for the altitude to which we are cleared and sets 250 knots on the air-speed selector.

Paris Air Traffic Control says, "You are

**Fly with Me in the New Jumbo Jet**  
 cleared to change to Approach Control  
 frequency." The first officer switches fre-  
 quency.

Monitored by radar, the captain is ad-  
 vised, "Expect vectors to ILS (Instrument  
 Landing System) runway seven. You are  
 cleared to 3,000. Maintain a heading of  
 zero nine zero."

"This is Pan Am 100," radios the first  
 officer. "Steady at 3,000."

"Roger, you are cleared for ILS."

**Coming in.** The first officer lowers the  
 flaps. The captain selects a 150-knot speed  
 or the thrust levers. To hook on to the  
 ILS, he puts the autopilot on its "heading  
 mode," tuning his ILS receivers to the  
 ILS frequency.

As our plane approaches the ILS localizer  
 beam—lining it up with the runway—the  
 captain switches the autopilot command  
 knob to Landing Position. Obediently, the  
 plane turns to follow the localizer. As it  
 approaches the outer marker, a vertical  
 radio beam that flashes a light on the in-  
 strument panel, the autopilot engages the  
 glide slope leading down to the runway.

"Threshold speed," reports the flight en-  
 gineer, "will be 130 knots."

The captain sets his autopilot to 130.

Flight-director computers are issuing  
 split-second instructions to the autopilot for  
 smooth roll-and-pitch commands to main-  
 tain the lineup with the runway and re-  
 main on the glide slope. Captain and first  
 officer each has before him a battery of in-  
 strument "comparator" lights. They signal  
 instantly any disagreement among instru-  
 ments reporting on roll and pitch, heading,  
 and the localizer and glide-slope signals.

At a height of 75 feet over the runway, a  
 red light glows, showing that the flareout  
 system, to lift the plane's nose and grease  
 the landing wheels on to the concrete, is  
 working.

**Touchdown.** As the plane touches, the  
 captain presses his autopilot-disconnect  
 button on the control of his yoke to lower  
 the nose, raises his speed-brake handle to  
 spoil the wings' lift, and pulls the engine  
 reverse levers. We taxi to parking position.

Engines are shut down. Passengers be-  
 gin deplaning. At two a.m. by the wrist-  
 watches of those passengers who hadn't  
 thought to set them ahead, day is dawning.

That's mass air transportation, just  
 around the corner.

25

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## Around the World with Color TV

*[Continued from page 105]*

voltages, to the crayons that fill in the colored areas.

The disguised R, G, and B signals mentioned above are known as color-difference signals. They are made at the studio by electronically subtracting the voltage from each of the three color vidicon output voltages to produce: R-Y, G-Y, and B-Y.

Actually, only two of the difference signals—normally R-Y and B-Y—need be nestled into the transmitted signal along with the Y signal. Because the three different voltages are closely interrelated, the third—G-Y—can be instantly deduced within the set's color-decoding circuitry.

A little thought will verify that the total scene brightness, Y, is equal to the sum of the red, green, and blue brightness components. Thus:  $Y = R + G + B$

When any color set receives R-Y, B-Y, and Y, a bit of high-speed signal juggling within a matrix circuit creates G-Y.

**Color signal and color differences.** In all color receivers, the video (or Y) portion of the received color signal is fed to all three picture-tube electron guns simultaneously, at the same time as the individual decoded color-difference signals are fed to their corresponding electron guns.

Thus, at each electron gun, the Y signal and the appropriate color-difference signal add together to produce a close replica of the output signal of one of the studio camera's three vidicons:

At the red gun:  $R-Y + Y = R$

At the green gun:  $G-Y + Y = G$

At the blue gun:  $B-Y + Y = B$

All we have said so far applies to the N.T.S.C., PAL, and SECAM system as a group. Now let's look at their individual differences.

**N.T.S.C.** The varying R-Y and B-Y difference signals are impressed simultaneously on a 3.58-megaHertz subcarrier by a complex process called quadrature modulation. The end result is that the instantaneous amplitude and phase (instantaneous position of the subcarrier's wave fronts with respect to time) of the subcarrier are constantly changing. The quadrature-modulated subcarrier and the Y signal are blended together, and the pair are combined with a synchronizing pulse—or sync pulse—to produce the composite color-TV signal. The sync pulse's job is to lock to-

gether the receiver's sweeping electron beams with the scans of the four pickup tubes in the camera. Also, an N.T.S.C. sync pulse contains a few cycles of the pure subcarrier impressed on it.

Inside the color-decoding circuitry of an N.T.S.C. set the received modulated subcarrier (labeled the color signal in a diagram) is amplified, and then fed to two synchronous demodulators. The color-oscillator circuit, which is kept in step by the bursts of subcarrier impressed on the sync pulses, sends a 3.58-megaHertz signal to the demodulators.

Within the demodulators, the amplified color signal is compared with the oscillator's signal to reproduce the original R-Y and B-Y signals.

**SECAM.** This system eliminates the finicky phase-sensitive modulation process by the simple technique of not transmitting the R-Y and B-Y simultaneously. Rather, they are transmitted sequentially: first R-Y, then B-Y, then R-Y again, then B-Y again, and so on. The signals are frequency-modulated on the subcarrier.

But there's a rub: B-Y and R-Y signals must reach the matrix simultaneously to produce a G-Y output. The solution is to provide a delay-line "memory" that stores each modulated subcarrier segment in turn until the next segment arrives. Both are then fed to the detectors together, to produce R-Y and B-Y signals.

The electronic switch simply reverses the various connections to and from the delay line with each incoming segment. This is done because the first segment stored in the delay line contains R-Y data; the next segment, B-Y; the next, R-Y; and so forth.

**PAL.** This system starts with the same quadrature-modulated subcarrier as the N.T.S.C. system, but adds the interesting twist of transmitting the same segment of modulated subcarrier twice: once during each of two successive CRT beam sweeps. The only difference between the two segments is that the phase of the second segment is electronically reversed from the phase of the first.

A delay line, as in the SECAM system, stores the first segment until the second arrives. Then the two signals are electronically added together to produce the R-Y and B-Y output signals.

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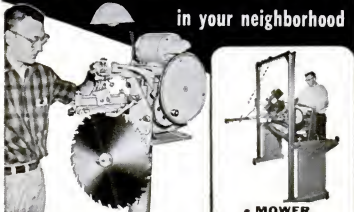
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## Frigid 'Perpetual Motion' Machines [Continued from page 95]

is slowly lowered into the Dewar and helium is added. Its windings, nine strands of niobium-zirconium wire, are embedded in a copper strip to keep the superconductor from developing hot spots and going normal. Thick aluminum cylinders support each layer of windings—to keep the immense forces within the magnet from bursting it with explosive violence.

A DC generator (superconductors *do* rapidly develop resistance to high AC currents) hums in the background as the magnet begins to charge. The process will take 25 minutes and when it is complete the magnet will hold energy of five million joules—equal to 9½ sticks of dynamite.

**Five million joules—for what?** I asked my host, Dr. Z. J. J. Stekly, what such huge magnets could be used for.

"MHD power generators are one possibility," he told me. "Avco has already built a prototype that generates electricity from ionized hot gases passing through the magnetic field. Among other applications are magnets for accelerators, bubble chambers, and other research devices.

"They may be used to create magnetic 'bottles' for containing the plasma in generating power from thermonuclear explosions. It has even been suggested that the magnets be used to shield spaceships from the deadly radiation emitted by the sun.

"Avco is studying superconductivity for ship propulsion. A large superconductive electric motor may prove economical."

How close are we to superconductive transmission lines—nonresistive lines saving millions of watts of power? Dr. John K. Hulm of Westinghouse expresses cautious optimism. "They're close to being practical," he told me. "In the near future we'll reach the point where the economics will be such that we'll build them."

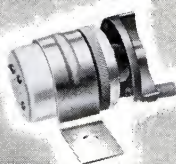
Dr. Hulm is in the forefront of researchers working to extend the top temperature at which superconductors operate, currently 18 degrees Kelvin.

"We'll find materials that exhibit superconductivity in the 20s," he told me. "And then we'll be able to use inexpensive hydrogen that boils at 20 degrees for cooling. Insulation will be simpler, cheaper. Who knows what we'll discover—with superconductivity we're at the stage where Faraday or Tesla were with electricity."

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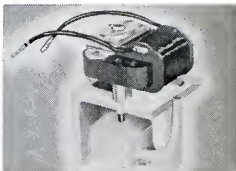
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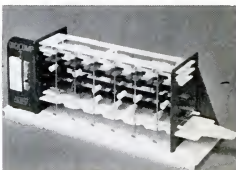
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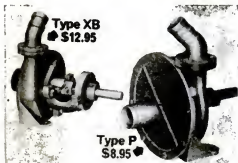
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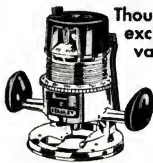
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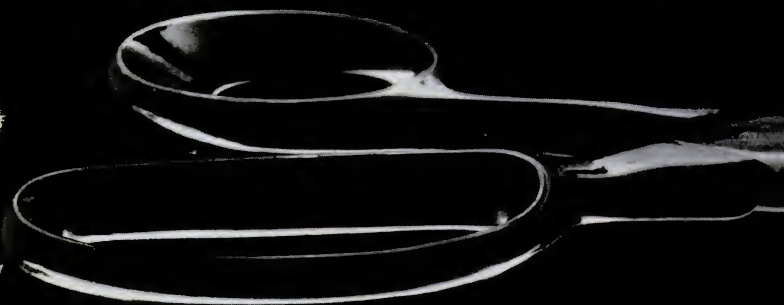
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**Flavor that  
goes with fun**

If you're not smoking Winston,  
you're missing out on the  
best taste in filter  
cigarettes.

**Winston tastes good...like a cigarette should** *(like your cigarette should)*